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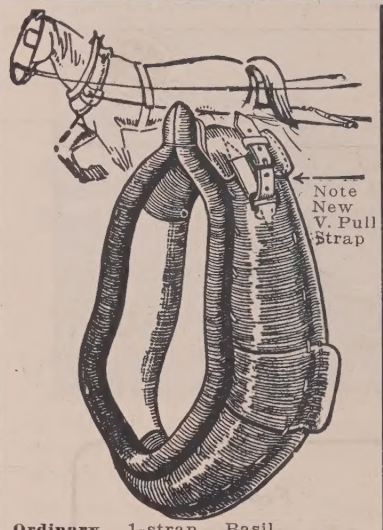

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By

R. D. WATT, M.A., B.Sc.
Professor of Agriculture, University of Sydney.

[*Presidential Address delivered at the Third General Meeting of the Australian Institute of Agricultural Science, University of Melbourne, 4th November, 1940.*]

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To our Institute and what it stands for, 1940 is also a notable anniversary occasion.

For it was in 1840 that Liebig presented his first Report to the British Association at Glasgow on his "mineral theory" of plant nutrition which may be said to have placed agricultural science for the first time on a sound foundation, and it is no exaggeration to say that there has been greater progress in agriculture in the century that has elapsed since then than in all the previous centuries put together.

Again it was in 1910, just 30 years ago, that the first Chair of Agriculture was founded in any Australian University, while the 40th anniversary of the foundation of our Institute also took place this year. Perhaps some future historian will attach to these two latter events a significance to Australia akin to that of the first for the world at large.

The objects of our Institute are many and varied. Like similarly constituted bodies, it aims at maintaining or improving the status of its members, but that is an aspect that is likely to be kept in the background while the fate of the Empire is being decided on the battlefield. To my mind our greatest achievement is that we have created a brotherhood of kindred spirits

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Again it was in 1910, just 30 years ago, that the first Chair of Agriculture was founded in any Australian University, while the fifth anniversary of the foundation of our Institute also took place this year. Perhaps some future historian will attach to these two latter events a significance to Australia akin to that of the first for the world at large.

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fellowship of all interested in the advancement of agricultural science and the improvement of agricultural practice—which is enabling us to speak with a united voice, to pool our common knowledge and to cooperate in important projects as members of a united team with a consequent increase in our capacity for useful service to the community.

It is, of course, quite impossible to make even brief reference to the diversified activities of our members, but, as far as lies within our power, we must concentrate largely on certain major objectives. We must try to ensure that the fertility of our greatest national asset, the soil, is maintained and that indeed its most valuable portion—that surface layer which has taken centuries to build up into a suitable medium for plant growth—is not lost altogether. We must use our influence to see that the very best possible use is made of our soil with due regard to climatic and economic conditions so that we may earn the undisputed right to occupy and hold this great land of ours. We must bring all our knowledge and skill to bear on improving the productive capacity and more especially the quality of our crops and crop products by the introduction or evolution of still better varieties and strains, and ensuring their maximum protection against injury from diseases and pests. We must continue to instill into the minds of our stock owners those principles of breeding which we know to be so important from our studies of genetics and inheritance. We must hold before them the ideal that, except perhaps in seasons of abnormal drought, every farm animal should at all times be adequately and suitably fed. We must bring all our knowledge and research ability to bear on widening the range of our dairy products and ensuring their high quality and uniformity. We must direct our attention increasingly to the successful preservation, storage and transport of perishable commodities, the encouragement of new uses for products of the farm, and the satisfactory utilisation of by-products. These are just some of the things we must attempt with ever-increasing vigour so that our primary producers may have at least the same advantages as their competitors in the abnormal markets of the present and the problematic markets of the future.

Neglecting for the moment the military situation, it is therefore no exaggeration to say that the future of this great Commonwealth lies largely in our hands. With our special knowledge and training we are largely the trustees for the future of Australia. This trusteeship is at once a great privilege and an enormous responsibility.

It is obvious, therefore, that individually and collectively we must continue to impress the powers-that-be with the necessity for encouraging and advancing the three main phases of our work—education, research and extension.

Education.

Taking, first, education ; one of the most important aspects of all our work is the education of the actual primary producer—not so much in the direction of increasing his skill in the ordinary routine operations of the farm as education in the underlying principles of his calling and in the manifold applications of the various sciences to his problems. This properly comes under the third phase—Extension—but I mention it here because our task would be greatly simplified if the farmer had received some basic scientific knowledge, however elementary.

That is one of the reasons why agricultural education must begin in the school. It is now pretty generally conceded that a course in general science is an excellent training for citizenship. If properly handled, an agricultural

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course in a school should be primarily a general science course with special emphasis on its application to rural problems. There is no reason why much of the illustrative material for such a course should not be chosen from the soils of the neighbourhood, the crops specially grown in the school garden with their accompanying parasitic foes, and from the domestic animals of most importance in the district. The ultimate aim should be to have such a course taught in every rural school throughout the Commonwealth. It is not only the future farmer who would benefit from it, for it is a subject which makes a special appeal to a large section of students who profit most educationally through dealing with things which come within the range of their everyday experience – things which they can see and handle. There are many who think that any kind of vocational education should be postponed till a later stage, but a very large proportion of our future farmers would miss the elements of an agricultural education if it were not introduced before the compulsory school leaving age is reached. It is quite true that much better results can be secured if the agricultural education can be continued as the main feature after leaving school, and that is where our Australian type of agricultural college comes in. It is debatable whether students at such institutions should not devote more of their time to obtaining a better grasp of underlying scientific principles and less to acquiring special skill in various farm operations, many of which could be just as easily learned under more normal conditions on a private farm or station. The agricultural colleges have undoubtedly been a very potent factor in the past in the dissemination of agricultural knowledge throughout the whole community, while their activities in certain specialised directions such as the manufacture of dairy products and some branches of animal husbandry have been invaluable. If the good work is to be continued and the highest return for public expenditure is to be ensured, the educational standards for entrance should be periodically amended in an upward direction.

The need for a more intensive form of education which would result in the supply of an increasing number of young men capable of investigating more fundamental aspects of agricultural problems was the main reason for the establishment of Chairs of Agriculture in our various Australian Universities, and the greatest credit should be given to the men who had the vision to recognise the need and the force of character to translate it into action. All credit too is due to those far-sighted benefactors who have already done much in the past, and we hope will do still more in the future, to advance the cause of higher agricultural education and research. In every State except Tasmania, University Faculties or Departments of Agriculture have been instituted and each has progressed and developed according to its special circumstances and requirements. The small numbers of students at these institutions in the early days did not perhaps justify the expenditure necessary for the staffing of each for adequate instruction in all the multifarious branches of agricultural science. The natural result has been that each has developed certain lines of study and research more than others, and the time has arrived when there should be greater collaboration and reciprocity between them so that it should be easy for graduates of one university to engage in post-graduate study and research at another in those branches of knowledge in which it has been enabled to specialise.

Research.

That brings me to the second of our main functions—Research. In every progressive country of the world the intensification of scientific research

on the problems of the primary producer has been an extremely important factor in the advancement of the land industries, and Australia is no exception to the rule. The striking successes in many directions have led to a rapidly increasing demand for such investigations, so much so that the Commonwealth Government felt impelled to enter the field in order to supplement the work of the universities, the agricultural colleges and the State Departments of Agriculture through the formation of the Advisory Council of Science and Industry in 1916, which developed into the Institute of Science and Industry in 1920 and was finally reorganised and greatly increased in scope and functions as the Council for Scientific and Industrial Research in 1926.

We have thus a multiplicity of organisations with ever-increasing facilities for investigation. Obvious possible drawbacks to this complex system are the dangers of overlapping of effort and of jealousy as to respective fields of work. The best corrective to both is, or should be, that we are all members of the same Institute of Agricultural Science, and I firmly believe that this common membership is exercising an increasingly important influence in overcoming these difficulties. Again, very few of the problems with which we are confronted are capable of solution by a single investigator and the call is more and more for teamwork. Here too our Institute is already doing useful work as, for instance, in our survey of the potential land resources of the Commonwealth and the improvement of our quarantine regulations and of the machinery for carrying them out. My strongest appeal goes out to all members to do everything in their power to encourage this essential team spirit between government department and government department within each State, between different branches of the same department, between departments and educational institutions in different States and between Federal and State authorities ; for in spite of the rapid increase in our ranks the labourers in the field of agricultural research are all too few when we consider the number and magnitude of the problems awaiting solution. Let us remember at all times that we are members of a great brotherhood and, as in the field of sport, that the winning of the game is always much more important than the receipt of credit by the individual member of the team. It is rather tragic that much of the long-dated agricultural research work in Britain has had to be temporarily abandoned for extension projects likely to have a more immediate effect on the all-important home food supply. The same kind of change-over is inevitable here, too, but it is sincerely to be hoped that, if we have to give up some fundamental investigations, all the records and materials will be carefully preserved so that the researches can be resumed when normal conditions return.

Extension.

As already indicated, the improvement of agricultural practice by the diffusion of the results of research and the placing in the hands of the producer of every new weapon known to science to help him in his battle with the forces of nature is the ultimate aim of all our work. Now the success of efforts in this direction depends more on the attitude of the man on the land himself than on any single factor, and it is extremely cheering to observe the rapid and progressive improvement in the outlook of an increasing number of producers during the last 20 years. There are many whose eyes and ears are ever open for the very latest information and some, indeed, whose faith in what scientific research can do is frequently rather embarrassing. There are many others, however, to whom the lessons learned from research filter through much

more slowly, largely because they do not realise that most of the appliances they possess and the varieties they use are the results of patient and prolonged research, and consequently that they should be constantly on the outlook for further improvements and ideas. I have already indicated one way in which this all-important attitude can be strengthened and fostered while the future farmer is still at school. There are others of course, such as the Agricultural Bureau and the Junior Farmer movements, and the holding of various types of field competitions. All of these agencies should be fostered and encouraged, for I would emphasise again that the success of extension work depends more on the attitude of the recipient than on all the efforts of those who endeavour to impart the information.

The scepticism and inertia which still exist in a few quarters can be partly attributed to advice given in the past which was not based on scientific investigation, and consequently frequently proved unsound. One of the main problems today, when the volume of sound research is increasing so rapidly, is to translate scientific findings into language which the farmer and settler can readily understand and appreciate. Speaking generally the research worker is not the ideal person to carry out this task, and the times call for more and for better trained extension and publicity offiecrs who are capable of understanding more fully the significance of individual researches and of communicating the main deductions to our producers in plain and simple language.

The advancement of science in other directions has added to the equipment of the extension worker in the form of the broadcast talk and the cinematograph ; but these appeal to a comparatively small proportion of those we desire to reach and much the most effective method, where it can be applied, is actual demonstration on the farm. Perhaps the weakest link in our whole chain is the comparatively slow rate at which the knowledge acquired as the result of research is being translated into agricultural practice.

The Institute and the War.

Nearly all the time I have been talking as if we were living in normal times, and my words might appear to have an air of unreality when we remember that our Empire is engaged in a critical struggle—the most momentous in her history. The question uppermost in all our minds and thoughts is, " How can we collectively and individually contribute more effectively to victory in this battle for the world's freedom ? " We simply dare not contemplate failure as otherwise all our labours, and indeed life itself, would be meaningless.

Soon after war broke out our Institute offered its services to the Prime Minister in any capacity the Government chose to use us, and that offer still stands. Experience, however, has shown that it is unwise to wait for a lead from a government whose hands are so full with unaccustomed tasks and we must therefore, wherever possible, take the initiative ourselves. Many of our members, of course, are engaged in definite projects to increase the supply of much-needed commodities which may be regarded in a strict sense as war materials, and those who are not so directly engaged may feel a sense of futility and may even question the judgment of the authorities who have placed most us in reserved occupations. The reason why I have recapitulated some of our main peace-time duties is simply this : that the best thing we can do may be to carry on with our normal jobs with even greater energy and vigour. Knowing what has happened in the last six months, he would be a bold man who would

venture to predict the future course of the war, but it is quite possible that it might resolve itself into a war of material resources in which the products of the soil may play an all-important part. While that should be a comfort to us, we must apply ourselves more and more to the encouragement of the production in ever-increasing abundance of those foodstuffs and raw materials the need for which has been clearly indicated by the British Government, and to fostering the production of essential commodities for local consumption, the supply of which has been cut off or may be cut off by war conditions.

Animal Husbandry.

Generally speaking, as far as foodstuffs are concerned, the main demands are for the products of animal husbandry. It looks as if, for the duration of the war at least, Australia will have difficulty in supplying her full share of Britain's requirements for butter, cheese, and condensed and dried milk. Climatic conditions have been very unfavourable in many of our dairying districts in the early part of this season, and the question arises whether we should not be rationing ourselves in dairy products in order that we may come nearer to what is expected of us in the way of exports to the United Kingdom. There are two main methods of lifting dairy production, viz. increasing the number of cows in milk or seeing that the cows are better fed. It would be better to promote the former by saving most of the heifers from our dairy herds and keeping reasonably good producers of proved dairy type a year or two longer in production than to attempt to bring beef-type or nondescript cows into the milking bails.

The second alternative offers much better prospects of quick results. In spite of the increasing efforts in the way of fodder conservation and pasture improvement and the growth of crops to be grazed or fed green, there is still far too great a difference in the production of milk in good and bad seasons. For instance, there have been differences of 37,000,000 lbs. in the yield of butter and 12,000,000 in cheese in two recent consecutive years, simply because the cows were better fed in the more productive years owing to the more abundant natural growth. The number of dairy cows was almost identical and they were substantially the same cows, so that the difference could only have come from the feeding. Could there be more striking evidence of the need for much greater efforts in the way of pasture improvement, pasture management, the better conservation of fodder and the use of concentrates during dry spells ?

Breeding from the highest producing cows and the selection of pure-bred bulls from proved high production strains should receive more strenuous encouragement than ever, although the advantages from this procedure can only be obtained over a longer term. In spite of the competition from the greatly improved margarine of recent years, it would appear wise to encourage the dairying industry even as a long-term project, owing to the disappearance of Denmark and other European countries from the British market for some years at least. If the popularity and cheapness of margarine should reduce the price of butter in future, we must concentrate still more on improving the quality and uniformity of our butter and reducing the cost of production—both of which can be done by utilising to the full knowledge which we already possess. In the more favoured parts of our wheat belt there is no reason why dairying should not play an increasingly important part, but for success there conservation of fodder is even more important than in our typical dairying districts.

With regard to pig products the demand is a little more uncertain, but it is highly improbable that however great our efforts we will be able to produce more than our own requirements and those expected of us by the United Kingdom for the duration of the war at least. Here we have the advantage that the species in question is capable of much more rapid multiplication. As the Australian Agricultural Council points out, however, one potential serious impediment will arise if a large proportion of separated milk from our dairy farms, on which so much dependence is placed at present, is to be turned into dried skim milk and exported. There is, however, too little appreciation in Australia of the pig as a grazing animal and far too little attention is at present paid to crops which this voracious feeder can harvest for itself. With the wheat position as it is there should be no lack of cereal foods for topping off, and the fewer the obstacles placed in the way of wheat and other cereals and the by-products of the milling industry reaching the raisers of pigs and poultry at a reasonable price, the better. There may still be a lack of a sufficiency of protein-rich foods which might quite well come in increasing amount from products and by-products of our abattoirs. In war time the British market may be a little less discriminating than usual but, especially if the export industry is to be retained as a permanent one, we must study more closely the requirements of that market and see that an adequate proportion of our production is sent in the form of frozen carcases from which the type of rasher which appears on nearly every British breakfast table can be manufactured at the other end. In connection with the pig-raising industry, the shortage in Australia of qualified departmental extension officers may be a serious drawback to progress and we should not hesitate to use the knowledge of successful men in the industry who would doubtless be willing to visit farms and place their valuable experience at the disposal of those desirous of engaging in the industry for the first time. They could give useful advice about the choice of site for, and the construction of, piggeries and also concerning methods of feeding and even the source from which suitable types of breeding stock could be secured. Many of them would doubtless be very glad to perform such tasks as their special contribution to the war effort.

In spite of Sir John Orr's placing of eggs-in-the-shell right at the bottom of the list of food commodities, when judged by the number of calories per cubic foot of shipping space, it will be difficult to wean the average Englishman from his traditional habit of accompanying his rashers of bacon with one or two fried eggs if they can possibly be obtained (it may even affect his morale) so that again I would say that there is little danger of our overstepping the limit of production, especially as the hatching season is now over for another year. If considerations of shipping space should make the export of eggs in the shell impracticable, there is still the alternative of sending them home as frozen pulp or even in the dried form, although the technical difficulties in the case of the latter have not been entirely overcome. Here again our citizens would probably appreciate the opportunity for some sacrifice in the way of rationing if it should prove advantageous to the much harassed people of the Old Country.

As our wool has been sold for the duration of the war and for one year thereafter, thus giving Britain and her allies a considerable advantage over their enemies so far as service uniforms are concerned, this industry can carry on in its usual way, paying still greater attention to such things as breeding to improve the quality of the clip, and pasture improvement and fodder conservation where these are practicable. It would also appear as if our

fat-lamb industry could continue its normal development, the war-time demand for cross-bred wool being an element in its favour. It is unfortunate that war conditions have eliminated, for the time being, our promising chilled beef trade, but there should be no slackening in the breeding of the early maturing types and strains of cattle which would normally supply this trade so that it may be resumed promptly when transport conditions are again favourable. In the meantime the placing on the local market of the kind of beef normally exported in the chilled state should so impress the discriminating purchasers that remunerative prices should be obtainable, with a consequent demand for improvement in the average quality of the meat which has been tolerated by the Australian public in the past.

Plant Products.

With regard to our major agricultural product—wheat—it is distinctly unfortunate for Australia, but very gratifying for Britain, that an abundant supply is available from her own increased production and more especially from countries nearer home, involving a much shorter sea voyage. Indeed the surplus of Canada alone would appear to be more than sufficient for some time to come.

It is extremely difficult to predict what the wheat situation will be after the war, but the present position indicates quite clearly what has seemed inevitable for some time : that some of our marginal wheat areas must go back to grazing for a period at least and that in the more favoured portions of the wheat belt the movement towards combining various forms of animal husbandry with wheat growing must be accelerated. The latter is a perfectly natural phase of our land utilisation programme and would have many accompanying advantages such as a more certain income and more varied interests on the part of the farmer, the conservation of fertility, the control of weeds of arable land and the prevention of soil erosion. Our sympathy naturally goes out to our wheat-growers, who are experiencing the worst season for 20 years and who have been the victims of an almost continuous period of low prices for the last decade, which greater efficiency and improved technique have not enabled them to counter. When one considers how most of our secondary industries and some of the primary industries have been subsidised, directly or indirectly, one should not grudge them continued financial assistance from our governments to tide them over another critical situation.

The lack of immediate demand for wheat is shared by many other agricultural products such as those of fruit culture and viticulture, some of which belong to the luxury class and are less necessary in time of war, especially when preference for shipping space has to be considered so carefully. The most acceptable for various reasons are the products exported in the dried form, and one wonders whether a greater outlet could not be found for fresh and canned fruits and even wines if the markets of British or friendly countries nearer our shores like India, the Federated Malay States and the Dutch East Indies were more fully exploited, although shipping space may be at present a serious problem. A rapid expansion of the fruit juice industry which has made such wonderful strides in America, Germany and Britain might also help to relieve the marketing difficulties to some extent.

When we come to fibre crops the position is different, for there is an urgent demand for their products both in Australia and Britain. It is fortunate that we have kept alive our small flax-growing industry and our more ambitious efforts in the way of growing cotton, for they have provided us with the nucleus

for rapid expansion, and it is a wise plan to take away investigators and instructors from less essential lines of work to give these industries every assistance from a cultural and technical point of view. I have a feeling that even more could be done in this regard. Nor are flax and cotton the only fibre plants whose increased cultivation should be encouraged, as ramie fibre has properties which render it even more suitable than flax for certain war needs and there is already evidence that the crop can be grown in parts of the coastal areas of Queensland and New South Wales with at least some promise of success as a permanent industry.

There is another class of agricultural product for which there is an increasing local demand and in connection with which we might be of service to the homeland, viz. seeds of vegetable crops and pasture plants. More and more attention will therefore have to be given to the technique of growing, harvesting and cleaning the very best varieties and strains of them.

War conditions have drawn increased attention to agricultural products which we normally import, and to the possibility of growing them within the Commonwealth. Many of these, like tea, coffee, cocoa, rubber and jute, can almost entirely be ruled out on climatic grounds, but others, like tobacco and linseed, are temperate climate crops. The former we have, of course, grown for several decades, but the industry has had many ups and downs, two of the major troubles being blue mould disease and the unsatisfactory burning aroma of much of the local leaf. The blue mould trouble, in the seed beds at least, has now been practically eliminated by the benzol treatment and the burning aroma is being gradually improved by various means, including the selection of more suitable soils and beneficial changes in the technique of growing and curing. The result is that an increasing percentage of local leaf can be included in mixtures without raising too great complaints on the part of the consumers. Investigations in progress may be expected to bring about further improvements with the probability that more and more people should be able to make a living on small holdings, and a considerable amount of " exchange " saved. With regard to linseed which, although derived from the same plant as flax, requires rather different climatic conditions and a different growing technique for best results, a good deal of exploratory work has been done over a series of years without any great promise of success. As in many other cases, the solution will come when we get the most suitable varieties and select the most favourable soil and climatic conditions. The most encouraging results so far have been obtained on the Murrumbidgee Irrigation Area, where there is every prospect that the industry will be built up on a considerable scale within the next few years with the same double benefit to the country as in the case of tobacco.

The secret of the successful growth of other oil-bearing seeds like soy-beans and sunflowers probably lies in the same direction—the choice of the very best varieties for our particular conditions and the selection of the proper localities with regard to soil and climate. There are a great many minor imported crop products such as beans for canning, gherkins, dried herbs and the species of mint from which peppermint oil is made—at present almost or quite unobtainable—which could probably be grown and processed here at a profit during wartime, although there is no certainty that they could survive as permanent industries. The same is true of many medicinal plants, the drugs obtained from which are only required in relatively small quantities for the local market, one of the most interesting being ergotin derived from a well known plant pathogen. These are the subject of enquiry by a special committee, whilst other enquiries are also being made about the possibility of

growing plants which are useful as the source of insecticides like pyrethrum and derris.

The war has also presented new problems connected with the storage and preservation of many products of the soil over much larger periods than have previously been necessary. An important new series of duties thus falls on many of our members, and there is every indication that they are rising to the occasion. This much is certain, that we are infinitely better equipped in trained personnel for the investigation and solution of such problems now than we were during the last war. There does, however, still appear to be a lack of a central directing body whose main duty it should be to ferret out all problems which have a direct bearing on our war effort, and to refer them to the proper quarter.

Post-War Problems.

It is obvious, as has been indicated, that we must concentrate our endeavours as far as possible on everything which can in any way contribute to the victory of our arms, but we should at the same time spare some thought for the problems of reconstruction after the war. The verdict of history will be that the period between 1919 and 1939 was one of neglected opportunities and failure to solve international problems, admittedly of considerable difficulty. For instance, one of the world's greatest tragedies has been that in spite of the efforts of agricultural scientists to increase our knowledge and improve the technique of pastoral and agricultural production, too large a proportion of the world's population has been suffering from the evils of unemployment, poverty and malnutrition. One of the reasons, in my opinion, was that the statesmen and leaders of thought were too inclined to take a mental holiday as soon as they experienced the unspeakable relief from a period of four years of war. This must not be allowed to happen again, and we must insist that our voice shall be heard, because the agricultural industry is in many ways the most important factor in the situation. One of the few things about which we can be certain is that it will be an impoverished world which will emerge from the present struggle, and the restoration of a reasonable degree of prosperity must be one of the first objectives. Now it has been estimated that something like 70 per cent. of the world's population make a living from the soil. It is quite true that a large percentage of these throughout the greater part of Asia and in many tropical countries, and even in Europe, might be described as the peasant type, and the surplus products sold by each individual are small, though great in aggregate. A reasonable prosperity on the part of this 70 per cent. is extremely important in itself, but its repercussions on other sections are by no means negligible. We in Australia see very clearly the intimate connection between the profitableness of the primary industries and the general prosperity of the community. The same principle applies to the world as a whole. If the price of wheat is good, the Australian or Canadian farmer buys a new motor car and a wireless set, and if satisfactory prices are obtainable for the products which the Asiatic or African native has to sell, he may buy a bicycle or a gramophone, or some other product of the secondary industries.

Now the profitableness of the primary industries depends, of course, on cost of production on the one hand, and the market price on the other. Cost of production in Australia is still greatly affected by the nature of the season, but more and more by efficiency of management and capacity to take advantage of opportunities.

Market price, unless interfered with by political action, is affected almost entirely by the law of supply and demand. The sudden drop in the price of most primary products in the last decade has resulted in the greatest of all the industries becoming on the whole unprofitable, with a consequent decreased purchasing power for the products of the secondary industries, which in turn has increased unemployment and still further lessened demand. It is obvious, therefore, that prosperity cannot be restored until the agricultural industry is again profitable.

Our work is mainly concerned with the production side and the lowering of costs through efficiency of management, improving quality and therefore marketability, and pointing out opportunities for diversification, but we must also pay increasing attention to the economic or marketing side.

The disastrous fall in agricultural prices which set in about 1929 has usually been attributed to over-production, and wheat, rubber, cotton and coffee have been quoted as examples. But can we really say that wheat, for instance, has been over-produced in recent years when tens of millions of people in Asia and millions more in Europe and America have not had sufficient cereal grain to prevent semi-starvation ?

Wheat is one of the cheapest foods and it is the primary product for which the demand is least elastic, and undoubtedly the low price of recent years started with an abundant crop in all the chief exporting countries in 1928. That position might soon have righted itself with changing seasons but for the decreasing European demand through the general adoption of a policy of self-sufficiency, resulting in such anomalies as the people of France and Germany having to pay up to 10/- per bushel for wheat when they could have imported a better article from Canada or Australia at less than half the price. From the point of view of the exporting countries, and I believe of the world at large, the ideal for the future should be as near an approach as possible to complete freedom of trade so that each country could concentrate on those products for which it is naturally adapted.

In spite of the failure of various World Economic Conferences, I still think there is need for a great international organisation to facilitate exchange through monetary agreements and at the same time to exercise some measure of control over the production and marketing of wheat and other products of the soil so as to equate as nearly as possible supply and demand and thus ensure steady and profitable prices to the farmer.

Perhaps the most fruitful idea brought before any international conference or any committee of the League of Nations was put forward at one of the latter by the Australian delegation, viz. the linking of agriculture with human nutrition and health. If all the members even of the white races, had not only sufficient cereals but the requisite amount of dairy products, meat, eggs, fruit and vegetables fully to satisfy their nutritional requirements there would be no talk of over-production ; indeed it would place a severe task on the primary producers of the world, but I have not the slightest doubt about their being able to accomplish it.

The nutritional problem was the subject of special investigation in most progressive countries right up to the beginning of the war, and the prospective condition of a large proportion of the peoples of Europe when the war comes to an end is not likely to let the subject be forgotten. An additional cause of the almost universal agricultural depression during the last few years has been, of course, the fear of war and the rapidly mounting expenditure or armaments—the policy of " guns before butter ". When victory is won we must

each play our part in helping to evolve a better world in which confidence will take the place of fear, security will replace uncertainty regarding the future, freedom of exchange will supersede international barriers, a well-balanced and satisfactory diet will relieve the many sufferers from malnutrition and deficiency diseases and prosperity will replace poverty and want, on the basis of a more productive, a more efficient and a more profitable agriculture, stimulated by the constant aid of the agricultural scientist.

Agricultural Self-Sufficiency Measures in Europe

By

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That many European countries, and Germany in particular, have made great strides towards the development of self-sufficiency in food supplies is well known, but the extent of this development and the means used to bring it about are not so well understood. The matter is of great interest to all Australians because of its bearing on the European blockade during the war; to agricultural scientists because of the scientific methods used in these developments in agriculture and food production; and to farmers because of its effects on the European market for their products.

The political and sociological factors governing the drive towards self-sufficiency in Europe have been the subject of a paper by Grogan[1] and will not be discussed here. Some idea of the degree of self-sufficiency attained, however, can be obtained from the principal food import figures given by Grogan. He has shown that for the years immediately prior to the war the whole of Europe, excluding Russia (i.e. about 350 million people), imported annually from six to ten million tons of cereals and $4\frac{3}{4}$ million tons of oil seeds, mainly for animal feeding stuffs, together with four million tons of phosphates for fertiliser.

The most obvious method of increasing food production is the extension of cultivated areas. This has been possible only to a very limited extent in Europe, though the reclamation of certain areas, notably the Pontine marshes in Italy, has been given considerable prominence. At least four other methods are available, however, which have been very fully exploited, especially in Germany. These are:

(i) Changing the *types* of crops sown and the crop rotations.
(ii) The more efficient production of grassland and conservation of fodders.
(iii) The development of artificial substitutes for agricultural products.
(iv) Large-scale organisation for the avoidance of waste.

The question of storage of large stocks of materials to be drawn upon under conditions of blockade is also an important one. There is reason to believe that many of the vital non-ferrous metals have been imported for a number of years in considerable excess of the actual requirements of industry—no doubt the same position holds for certain human food materials of special importance such as cod-liver oil and whale oil.

Changes in Types of Crops Sown.

Tremendous variations in the quantities of nutritive substances produced per acre by the growth of different crops under average seasonal conditions have been observed in Germany. Thus Woermann[2] represents the coefficients of yield in nutritive substances (calorific value) per unit of area for Germany as follows :

Sugar beet	100·0
Potato	51·5
Mangold	41·6
Barley	31·5
Rye	26·7
Grassland	22·1

Another writer, Witt[3] gives the ratio sugar beet : potatoes : cereals as 3 : 2 : 1, which is very similar to that given above.

The special importance of the root crops and potatoes under self-sufficiency conditions is obvious, and great increases in their production and use have taken place in Germany over the last few years. The sugar-beet is not well adapted for direct use in human nutrition but the whole beets and the by products of sugar manufacture dried, ensiled and treated in various ways are playing an important rôle as fodder for pigs, cows and horses. The same remarks apply to mangels, while potatoes are not only being utilised in this way on a large scale but must be considered as one of the most important crops for direct human consumption.

The high carbohydrate content of these crops makes them especially useful for replacing the lower yielding cereals, but their protein content is very low. Heavy fertilisation with synthetic nitrogenous fertilisers is effective in raising the protein content of most crops to a certain extent but the problem of protein supplies has been attacked by the encouragement of special protein-rich crops and fodders. The increase in acreage of the sweet lupin (*Lupinus luteus*), which produces a highly digestible and palatable seed containing 40 per cent. protein as well as high-protein forage, is noteworthy in this connection. In 1933 there were only about 1250 acres of sweet lupin in Germany. This area had risen to nearly 160,000 acres in 1938.[4]

Plant breeders are also making great efforts to produce a variety of soya bean which will yield large quantities of protein under the northern and central European conditions.

Grassland Production and Utilisation.

The development of improved methods of raising the quantity and quality of grassland production and of conserving the herbage so produced represents one of the most notable advances in agricultural science and practice during the last 10-15 years. European countries, and especially Germany, have been well to the fore in this field—in fact the idea of close rotational grazing coupled with intensive fertilisation with nitrogen was first popularised in Germany and is still referred to as the " Hohenheim system ". This system aims at keeping the pasture species young and maintaining the production throughout the growing season of a protein concentrate of high digestibility, rather than of a roughage. This results in a much higher production of digestible protein per acre, thus reducing the demand for imported concentrates which was at one time a considerable factor in the dairying industry of most European countries.

Improvements in methods of preservation and storage of grass and fodders have been even more striking. The ancient and honourable process of haymaking has been shown to be very wasteful. The losses of available food nutrients can be reduced somewhat by the use of such aids as wire haycocks, but the development of modern ensiling methods and of mechanical dryers considerably reduces these losses. Their use has been very greatly stimulated in Europe during the last few years. An idea of the comparative efficiency of different methods of fodder conservation is given by the following table taken from Watson.[5]

Percentage Losses Incurred in Conservation Processes (Grass).

Process.	Number of Tests.	Dry Matter.	Starch Equivalent or Nett Energy.	Digestible Crude Protein.
Ordinary haymaking	39	22·1	43·9	34·6
Haymaking with special appliances	96	17·4	38·2	25·3
Ordinary ensilage	255	15·9	34·3	39·8
Stimulated ensilage (added molasses)	34	11·7	22·9	10·0
Acidified ensilage (A.I.V.) ..	74	12·4	23·7	10·0
Artificial drying	2	7·5	11·5	8·2

The advantages of artificial drying have been exploited particularly in England and Holland, though not to the same extent in Germany and Italy, where an enormous development in the production of modern types of ensilage made in tower silos has occurred. In Italy, government subsidies and propaganda have been largely responsible for an increase from 3,000 silos in 1928 to over 10,000 in 1937. In Germany the increase is even more striking. Between 1932 and 1938 there was a tenfold increase in silage capacity, with an actual average annual increase of approximately 1·5 million cubic metres.[4] It should be emphasised that the more efficient conservation of grassland was only one of the factors involved in this development. Perhaps the most important factor was the opportunity it presented of conserving special crops which cannot be made into good hay. The highly productive root crops such as sugar beet, mangels, potatoes and turnips have been ensiled in large quantities, particularly mixed with green fodders. These fodders come largely from " catch " crops sown with cereals or on cereal stubbles with the object of reducing the fallow periods of cultivated land. The increased sowing of such " catch " crops as red clover, lupins, vetches, beans, fodder mallow, etc., has been a feature of crop rotation in Germany of recent years.[4] A high proportion of the total silage made comes from these crops. In addition, it might be mentioned that even such unpromising material as bracken has been successfully ensiled and made into an edible fodder.

A further advantage of the modern methods of crop conservation lies in the fact that not only do they reduce losses of the major food nutrients but the mineral and vitamin losses are also reduced and in some cases completely avoided. The position in regard to carotene, the vitamin A precursor, is especially significant. In ordinary haymaking carotene is very largely

destroyed, whereas in the A.I.V. type of silage the loss is negligible. The molasses type of silage is rather more destructive of carotene but not nearly so much as is haymaking. In artificial drying the losses of carotene are only of the order of 25-33 per cent. The importance of this lies less in the fact that the animals themselves need the carotene than in the fact that the vitamin potency of their products, e.g. milk and butter, is directly related to the intake in their diet. In other words, the adoption of modern methods of crop conservation makes it easier to sustain the production of milk and butter of high vitamin A potency throughout the year. Where the fat intake per person is greatly reduced, as in Europe at the present time, this becomes a matter of some importance, especially as " night-blindness " is one of the first symptoms of vitamin A deficiency in the human !

The Development of Substitutes.

The large scale production of synthetic fuel oil, synthetic rubber and of artificial wool or staple fibres has, as is well known, played a prominent part in the self-sufficiency programmes of a number of the European countries but by no means exhausts the variety of substitute materials manufactured. The production of substitute foodstuffs, especially those supplying much protein, has also been attacked with a considerable degree of success.

This problem has been attacked along two principal lines. The first of these is devoted to exploiting the synthetic powers of various microorganisms. Strains of yeast have been cultivated which grow well on media containing sugar, minerals and inorganic nitrogen. An excellent feeding stuff of high protein (and vitamin) content containing very little alcohol can be produced in this way. Developments along these lines are known to have taken place in Germany during the last war but had to be abandoned because the molasses used became both scarce and expensive. At the present time, not only are there much larger supplies of sugars available, due to the great increase in the growing of sugar-beet, but supplies of " wood-sugar " are also being manufactured for this purpose.

That wood-sugar can be made by hydrolysis of wood pulp and wood waste with strong mineral acids has been known for many years, but the technical difficulties of production on an industrial scale have been great and the yields small. Intensive research in Germany directed by Dr. Bergius (following on his success with the production of synthetic oil from coal) has enabled many of the difficulties to be overcome and yields of 60-70 per cent. of the total possible sugars are claimed.[6] The wood-sugar can be mixed with potatoes and other foods partially to replace cereals in the diet of pigs and cattle as well as to supply the necessary carbohydrate in the growth of protein-producing yeasts.

The second of the lines of attack on the production of substitute foodstuffs relates to the partial replacement of proteins in the diet of ruminants with simpler synthetic nitrogenous substances such as urea, glycocoll and ammonium salts. These compounds cannot be utilised by pigs, poultry or human beings but the rumen bacteria of sheep and cows have the power to use them up to a point in the building of the proteins of their own bodies. These in turn can be broken down and utilised by the host animal. In this way they may act as protein-sparers, and urea in particular is being incorporated into a variety of feeding-stuffs, usually in the proportion of about 15 per cent. " Amino-slices ", a potato-urea and beet-urea combination and " amino-oil cakes "

constitute a significant feature of milk and meat production in Germany at the present time. Even in U.S.A. the possibilities of urea as a cheap source of nitrogen for dairy-cows is not being overlooked.[7]

The Avoidance of Waste.

The exploitation of waste materials and of industrial by-products has, to a certain degree, been a feature of all modern communities but under self-sufficiency programmes this exploitation has been raised considerably both in scope and status. The Anti-Waste Campaign (Kamph dem Verderb) in Germany has made extraordinary progress through the creation of a special service for the collection of all household rubbish which can be utilised in pig feeding. Many towns have built large pig-fattening stations where such waste is converted into valuable protein and fat for human consumption. Kalbrunner[8] reports the construction by the Germans of a station of this description in Vienna with accommodation for 4,400 pigs. It seems that the pig is becoming as important a factor in the European self-sufficiency programme as the potato.

Improvements in the production and utilisation of abattoir by-products such as meat meal and blood meal have also been introduced and special attention paid to the dairy by-product, whey. This is a product difficult and costly to preserve for storage and transport but a very valuable concentrated feeding stuff, especially in pig feeding. Not only is dried whey being obtained throughout the cheese-making industry in Germany, but the considerable quantity produced in the course of manufacturing textile fibres from casein is also being used, especially in Italy.

Other Measures.

No mention has been made of the many strictly political and commercial measures adopted to influence agricultural production towards self-sufficiency. Restriction of certain imports, reduction of railway tariffs, fixing of prices for different categories of crops and animals and their products, regulation of times of calving and periods of lactation in relation to fodder supplies, etc., are all important factors supplementing and complementing those mentioned in more detail above.

The Influence of the War.

It is clear that strenuous and highly successful efforts have been made in a number of the European countries, particularly Germany and Italy, to overcome, through advances in agricultural and industrial technique, the agricultural limits set by nature. The soil and climatic conditions in northern and central Europe are not nearly so well adapted to the production of protein-rich and fat-rich foods as they are to carbohydrate-rich materials. Much of the research and organisation in these countries has therefore been devoted to attempting to overcome this disability. That the measures adopted must be exceedingly costly, compared with more normal methods based on international trade, is obvious. In the ordinary way this increased cost can simply be passed on to the people as a whole in the form of a lowered standard of living, since the whole national economy is organised to the one end. The problems of labour and of distribution or transport, however, are not so readily solved in war time. Even such a simple process as replacing cereals by potatoes in the diet of pigs imposes considerable extra labour demands in handling and preserving such bulky material.

How far the extra labour and transport requirements of the self-sufficiency régime can be sustained in a country at war, which has a large proportion of its male population engaged in military pursuits and its transport system constantly harassed by the enemy, and in any case under frequent military requisition, is a vital question. The domination of most of the rest of Europe by Germany is important in this connection, since not only have important stocks of materials been obtained, but a supply of what is virtually " slave labour " has been obtained for those German and Italian industries which play such a part in helping to overcome the effects of the blockade. On the other hand, it must take a number of years to develop such industries to a significant extent in the conquered countries and perhaps even longer to bring the people to the same degree of regimentation in agricultural methods as has been developed in the totalitarian countries. Moreover it is difficult, if not impossible, to conceive of production in Europe going on at the same level during the war as immediately before it. Even during peace time, as pointed out in the opening paragraphs, Europe as a whole was an importer of cereals, oil seeds and mineral phosphates on a small but significant scale.

The long-term significance to Australian farmers of further developments towards agricultural self-sufficiency in Europe, including Great Britain, can hardly be overestimated. There is, of course, no evidence that such movements will necessarily develop further or even remain at their present level after the war. The realisation of what has been accomplished already in certain countries in this connection and what could be accomplished towards self-sufficiency by extension of the same methods to other countries as yet barely touched in this way must, however, remain a sobering thought for all those interested in Australian agriculture.

(1) Grogan, F. O. (*Vide* article in this issue.)
(2) Woermann, Deutsche Landwirtschaftliche Tiersucht, Nr. 4, S.69, 1936 (cited by Moskovits(4)).
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Agricultural Progress in Western Australia*

DEVELOPMENTS DURING THE PAST THREE DECADES

By

G. L. Sutton, Hon.D.Sc.Agr.,

Late Director of Agriculture, Western Australia.

A profound belief in the agricultural possibilities of Western Australia was coincident with its foundation. It has persisted since then and been amplified, so that it has become one of the proud characteristics of West Australians.

* Résumé of Presidential Address to the W.A. Branch on 26th April, 1940.

The history of agricultural progress in Western Australia can be divided into two main periods: the first of some 70 or 80 years, and the second commencing about the end of the first decade of the present century. The story of the first and longer period is of slow, uninspiring progress, accompanied by many difficulties, but nevertheless marked with dogged determination as a handful of people sought to develop a large territory. By contrast, the extent and rapidity of progress since 1910 are exemplified by the value of production. From 1839 to 1910, the aggregate value of wheat and wool produced was £7,000,000. From 1910 to 1939 the pastoral and agricultural industries (excluding, for comparison, dairying, poultry and bee farming) produced goods valued at £364,000,000, and so the past three decades may well be called "The Golden Age". Wheat, sheep, dairying, fruit production, potatoes, poultry and pigs; all have contributed to this enormous expansion, while new industries in tobacco production, dried vine fruits and fat lambs have contributed their share.

What are the factors which led to these wonderful achievements? The West Australian belief in the State's possibilities led to the most liberal land laws in the Commonwealth, and the generous credit policy of the Agricultural Bank. Further, in 1906, a noticeable decline in gold production followed a period of exceptional prosperity, and unemployment and loss of population were threatened. Mr. James Mitchell, now Sir James Mitchell, a Minister without portfolio, conceived a speeding-up of agricultural development, and so 1907 marks the commencement of the vast expansion in agriculture. The wheat industry was the first to develop, and the value of exported wheat rose from £7 sterling in 1906 to £7,000,000 sterling in 1928. Thus to a land of gold was added a land of golden grain.

As many of the potential settlers were more or less moneyless, the credit policy of the Agricultural Bank was liberalised to allow advances up to £2,000 per settler and to the full value of improvements made on farms. Associated banks, stock firms and other business people likewise adopted a sympathetic attitude, and although there have been repercussions and some losses, general progress has been maintained.

Statistics tell the story of material progress, but without the energy, enterprise and courage of the new settlers, progress would not have been possible. The women pioneers must never be forgotten for the hardships they endured and the unaccustomed tasks they performed to make homes and help their menfolk in these virgin areas, often far from railways and with deficient water supplies.

Four Commissioners for Agriculutre.

The enormous expansion east of the older recognised agricultural areas of the Avon Valley and the Great Southern district caused a big increase in the demands on the Department of Agriculture for information and advice on

farming practice. Accordingly in 1910 the Department was reorganised under four Commissioners, in charge of (1) Tropical Agriculture, (2) South-west, (3) Fruit Industries, (4) Wheat Belt.

The wheat belt, especially, called for a scientific approach to its problems, and in the years 1911 and 1915 it was possible to demonstrate to farmers that ball smut and Septoria spot respectively could be easily controlled if the results of experimental investigations were applied. Since that time Western Australian farmers have become gradually more scientifically minded. This outlook has been assisted by the training of graduates in agriculture, made possible by the endowment of a Chair of Agriculture in the University of W.A. by the late Sir Winthrop Hackett.

Experiment farms in the wheat belt at Merredin and Chapman contributed substantially to progress by the breeding of prolific, disease-resistant wheats such as Nabawa, Geeralying, Carrabin, Bencubbin, etc., as well as by supplying graded, selected pedigreed seed wheat and oats. Quality has always been in mind in the wheat breeding programme, and in recent years this policy has received tangible support from the W.A. Flour Mill Owners' Association in the provision of equipment valued at £1,500 for cereal research.

Sheep numbers in the agricultural areas increased threefold from two to six millions in the past three decades, and the average wool yield from 5·1 lbs. to 7·9 lbs. This result can be largely attributed to teaching farmers to realise the importance of breed, blood or strain for improvement and uniformity of type.

Since 1929, when surplus sheep were causing concern, the fat lamb industry has been established on a sound basis by the co-operative efforts of departmental officers and a consultative committee of farmers with vast experience in sheep husbandry. In 1938 over 360,000 lambs were exported.

The expansion of dairying belongs to the past two decades, and is intimately associated with migration from Great Britain after the Great War. To absorb immigrants, Sir James Mitchell, at this time Premier, conceived the Group Settlement Scheme to settle and develop the heavier rainfall areas of the south-west and to expand the dairying industry. The inexperienced migrants were to work in groups in the initial stages of development of the virgin forests to produce pastures.

The scheme brought many problems for agricultural science. Dairy stock required considerable improvement by the use of good bulls and the registration of all bulls was made compulsory. Further, to discourage indiscriminate mixing of breeds a zone system was adopted, and the purchase of bulls by government subsidy was restricted to the breed allotted to any particular zone. Official herd recording schemes for the main breeds, and later grade herd testing, were introduced to improve breeding stock and to encourage dairy farmers to eliminate low production cows. In 1938-39, 12,368 cows were under test and

the average production of tested cows had risen in five years by 21 per cent. to 218·7 lbs. of butter fat.

Pasture Improvement.

Pasture improvement was essential for a sound dairy industry, and was greatly assisted by the co-operation of Cuming Smith and Mt. Lyell Farmers' Fertilisers Ltd. with the Department of Agriculture in establishing experiment plots throughout the agricultural areas. The application of 1 cwt. of superphosphate per acre increased the yield of pasture threefold in the dairy belt, and also greatly improved its quality. The trustees of the Merchants' Agricultural Research Fund also devoted funds for some years to pasture improvement work. All these efforts resulted in enormous increases in acreages of sown pastures, and of top-dressed areas with subterranean clover as the outstanding species. Work by agricultural scientists on the various strains of subterranean clover for various conditions, and on the establishment of *Phalaris tuberosa*, perennial rye, cocksfoot, white clover and Paspalum continues to improve the pastures.

Agricultural science has also played its part in the fields of entomology and plant pathology, including notable successes against outbreaks of codlin moth and black spot or apple scab. Among stock problems the elucidation of the Denmark wasting disease of cattle and sheep, and the Braxy-like disease of sheep have been important contributions. Botulism of sheep has been controlled, and pleuro-pneumonia kept out of the south-western parts of the State by the application of the Turner modification of the complement fixation test to discover carriers of this disease.

Soil science has contributed to a better understanding of the soil salinity problems of the wheat belt and indicated the need for caution in the expansion of wheat growing beyond the present wheat belt on account of possible salt problems. In the past few years the importance of minor elements, such as copper, manganese and zinc, in plant and animal nutrition has been recognised, and in certain districts striking responses have been obtained and have altered the outlook for many farmers.

No longer is Western Australia a Cinderella among the agricultural States of the Commonwealth. Although the development of the past three decades has not been achieved without difficulties and setbacks, it has been an achievement in statesmanship, in courage, enterprise and energy, comparable with anything of a like nature in history. Furthermore, it includes notable triumphs for the application of science to agriculture.

Transmutation of Bacterial Plant Pathogens

By

A. T. Pugsley, B.Ag.Sc.,
Waite Agricultural Research Institute, S.A.

It was Arkwright who, in 1920, first directed our attention to the importance of the many changes which occur when colonies of bacteria of the coli-typhoid dysentery group change their normal smooth type of growth on agar to a type having a very characteristic rough surface. Since that time the study of this so-called " Smooth-Rough " variation has claimed the attention of workers in all branches of bacteriology, and the results already achieved have helped us to a much clearer understanding of the relationships existing among the different species and strains of bacteria.

To the pathologist who is interested in the diseases of plants and animals this study of Smooth-Rough variation has given a new method of approach to the many problems of resistance of the host on the one hand, and of the virulence of the parasitic bacterium on the other. In reading the literature of plant resistance to fungal and other parasites we are at once impressed, and perhaps overwhelmed, at the number and variety of the explanations offered to account for the resistance of plants to pathogenic organisms. Although no general underlying principle of disease resistance has yet been established for plant parasites as a whole (nor can we really expect one) some measure of success might attend our efforts if we were to restrict our attention to single groups such as, for instance, the bacterial plant pathogens. In the past, workers in this field, after demonstrating the pathogenicity of the bacterium, were usually content with a detailed study of its behaviour in culture media, with the result that we have learned little about their parasitism. It is only in recent years that the field has widened and the fundamental problem is being faced as to why it is that two bacteria, A and B, although indistinguishable in culture, may yet possess quite different parasitic habits.

However, returning to the study of bacterial variation, we now know that many characters of the organism are involved in the change from the smooth to the rough colony type. Perhaps the most fundamental and, from our present point of view, the most important is the loss of a specific polysaccharide antigen that characterises the " body surface " of the normal smooth form. The roughening process seems to expose a different " body surface " or somatic antigen so that we can regard the antigenic make-up of the rough form as being of a simpler and more basic type.

Now it is the loss of this specific polysaccharide antigen which seems to be directly responsible for the loss in virulence (partial or complete) which accompanies the S→R change. Possessing, as we do, a suitable technique for differentiating between the S and R somatic antigens, we now require some

method of changing at will, the organism's "body surface". If we can accomplish this, then a study of the accompanying changes in virulence will surely teach us something about the parasitic relations of bacterium and host.

Griffiths' Transmutation Work.

Commencing with the pioneer work of Griffiths in 1928, a technique has been developed whereby the rough variant can be made to acquire the power of resynthesising the specific antigen which it had lost in the S→R process, and so become a normal smooth type again. Griffiths, who worked with pneumococcus, was able to go a step further and build on to a rough strain a different antigen characteristic of another quite distinct serological type of the same species. After reducing type I strain of pneumococcus to its rough form, he injected mice with living cultures mixed with heat-killed smooth pneumococcus of another type. In this way he was able to secure from rough variants of type I strain a normal smooth type II or type III strain and so on. He had in reality been able to secure a transmutation of antigenic pneumococcus types. It should be mentioned that these rather startling experiments performed by Griffiths have since been confirmed by a number of workers.

An understanding of Smooth-Rough variation and this pneumococcus work enables us to appreciate the important researches of Harris, Naghski, Farrell and Reid at Pennsylvania Agricultural Experiment Station—an abstract of which appears in *J. Bacteriology*, 38 : p. 235, 1939. These workers, leaving the beaten track, have made a study of the green fluorescent group of bacteria in relation to tobacco wildfire disease. They have demonstrated a close relationship existing between *Phytomonas tabaci*—an organism long known to cause disease in tobacco, and *Pseudomonas fluorescens*—a species closely related to *Ps. pyocyanea*. *Ps. fluorescens* is commonly found in soil and water and on numerous occasions has been suspected of causing disease in plants.

After securing *Ps. fluorescens* in the rough form, they cultured it in the presence of its homologous serum together with killed cells of *P. tabaci*, and in this way were able to secure the normal smooth form of *P. tabaci* which was identical culturally, serologically and pathogenically with their standard cultures of *P. tabaci*. In a similar manner they were able to secure the normal smooth *Ps. fluorescens* from rough cultures of *P. tabaci*. It follows then that these two species should share a common rough antigen. This was shown to be the case, for the R strains derived from *Ps. fluorescens* and *P. tabaci* were serologically identical.

Further work showed the same relation to exist between *Ps. fluorescens* and several other members of the group namely *P. cerasi*, *P. primulæ* and *P. vignæ*.

Now we know that many isolated outbreaks of bacterial diseases occur where no satisfactory explanation can be offered to account for the origin of

the pathogen (e.g. certain diseases caused by strains of *P. syringæ*). In many cases the disease is an undescribed one, and even if we admit that it may have passed unnoticed in other parts, we have been unable to produce evidence to indicate how it gained entrance into its new environment. Up to the present we have not been able to go further than by merely supposing that some soil bacterium has acquired the parasitic habit. Then again, many bacterial plant diseases are no longer reported in our literature; it seems that they have disappeared altogether, and we do not know what has become of them. Studies on the lines of those reported by the Pennsylvanian workers will no doubt clear up many of these gaps in our knowledge. Their work on the green fluorescent group also illustrates the great value of the serological method of analysis in determining relationships among the plant pathogenic bacteria, and a detailed account of their studies will be awaited with interest.

TECHNICAL NOTES

A SHAKING MACHINE FOR THE SEPARATION OF SAND FRACTIONS.

The sieving of sand samples by hand has several disadvantages, the chief of which are the tedium of the operation and the large personal factor involved in deciding on a suitable end point. These difficulties can be largely overcome if the sieving is done by means of a mechanical shaker, using a standardised technique.

A shaking machine, designed for fractionating cement samples, was tried out for sieving sands. It has a vigorous reciprocating action in a virtually horizontal plane, and as set up is driven at a speed of approximately 200 revs. (or shakes) per minute. There is no device for giving a tapping effect to the sieves as usual on mechanical shakers. An automatic timing device throws the machine out of gear after a determined interval of time. A nest of four sieves and a bottom container may be clamped into the machine.

Trial sievings, using a nest of sieves of 50, 70, 90 and 120 mesh, soon showed that shaking alone was not sufficient to obtain a complete separation. After two hours' continuous shaking the separation was still far from complete, due to the meshes of the sieves becoming blocked with irregularly shaped particles Cleaning the sieves was then resorted to. A technique of alternate cleaning and shaking until the sieving was sufficiently complete was worked out, and it proved quite satisfactory when tested on nine soils. It was found that a convenient shaking interval was six minutes, and that it was necessary to clean the sieve about three times. Cleaning was accomplished by emptying the sieve of sand and smartly rapping the inverted sieve once or twice on the bench. This technique also proved satisfactory for the further separation of the fraction

smaller than 120 mesh, using the 200 mesh and 300 mesh sieves. A typical example is given in Table 1.

TABLE 1.—*Fractionation of Soil No. 6000.*

Treatment.	>50 Mesh. %	50–70 Mesh. %	70–90 Mesh. %	90–120 Mesh. %	<120 Mesh. %			Total. %
Machine sieved:								
2 hours' continuous shaking ..	36·4	23·5	9·9	9·4	20·7			99·9
1st shaking, 6 mins.	40·3	24·8	10·7	10·9	11·9			98·6
1st cleaning, 2nd ,, 6 mins.	28·9	23·8	12·5	15·8	17·8			98·8
2nd ,, 3rd ,, 6 mins.	26·3	22·5	13·6	16·4	19·6			98·4
3rd ,, 4th ,, 6 mins.	25·5	22·0	14·0	16·0	20·6			98·1
					>200 Mesh. %	200–300 Mesh. %	<300 Mesh. %	
4th ,, 5th ,, 6 mins.					15·95	1·65	2·8	
5th ,, 6th ,, 6 mins.					15·5	1·6	3·25	
6th ,, 7th ,, 6 mins.					15·35	1·65	3·35	
7th ,, 8th ,, 6 mins.					15·25	1·6	3·45	
Hand sieved	22·6	25·7	12·9	14·2	18·5	1·7	4·4	100·0

To make the investigation more complete, a group of gravelly, coarse sands was sieved on the machine through a nest of sieves of 2, 1½, 1 and ½ mm. diameter. The technique of alternate shaking and cleaning as for the fine sands was used. It was found that for these materials a six-minute shaking interval was sufficient, and the sieve need be cleaned only once.

The standardised procedure for mechanical analysis involves the separation of the sand fraction by means of a 70 mesh sieve into coarse and fine sand fractions. Since there was a difference in the relative movement of the individual sieves on shaking, it was necessary to know if position in the machine would influence the final separation of the sands. Duplicates of a soil were placed on two 70 mesh sieves in the machine one above the other and sieved by the technique described above. Then, in order to overcome differences inherent in the sieves themselves, fresh duplicates of the soil were shaken with the sieves in the reverse positions. Inspection of the resultant data showed that the position of the sieve in the shaking machine had no appreciable effect on the sand separation.

The process of dismantling, cleaning and reassembling the sieves seems time-consuming, but it does give reproducible results. It is possible on routine work to fractionate a sand in 30 minutes, or to separate fine and coarse sand fractions for mechanical analysis of two soils in the same time.

ROBERT SMITH.

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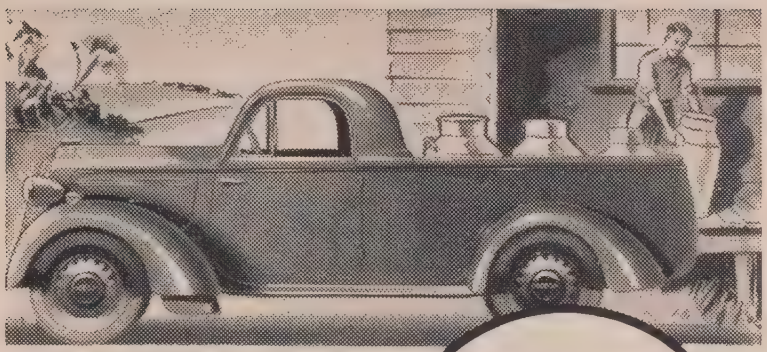

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WORKS: Parramatta, N.S.W.; South Kensington, Victoria; Port Adelaide, South Australia.

HOST RANGE AND DISTRIBUTION OF TOMATO BIG BUD.

In 1937, big bud of tomato was reported to occur on tobacco and to be graft transmissible to *Solanum nigrum* and *Datura stramonium*, two common weeds in Australia.[2] During the succeeding three seasons, the disease was observed in the field on these plants in several districts of New South Wales and Victoria. At Canberra, in March, 1940, big bud symptoms were observed on eggplant (*Solanum melongena*) in a home garden in which tomato plants were affected by the disease. The symptoms were similar to those obtained by grafting scions of tomato affected with big bud to healthy eggplant, and were also similar to those described by Thomas and Krishnaswami[4] for little leaf disease of brinjal (eggplant) in South India. What appears to be the same disease was also described by Paul[3] as a disorder of Capsicum species in Ceylon. In the U.S.S.R., the disease known as "stolbur" and "montar" was reported[1] as prevalent on tobacco, tomato and chili.

In South India, little leaf was transmitted by two species of jassids. Field observations in Australia indicate that an active insect, such as a jassid, is

Figure 1.
Big bud of eggplant, obtained by grafting a scion from an affected tomato plant on to healthy eggplant stock.

probably the vector. It is possible, however, that different vectors occur in each country, because, in Australia, the disease is comparatively common on tomato whereas in India, Thomas states (personal communication) that " so far, we have not had any case of natural infection in tomato plants, though a large number were grown in the vicinity of diseased brinjal for two seasons ".

Figure 2 (*a*).
Flower from healthy eggplant.

Figure 2 (*b*).
Flower from infected eggplant.

Symptoms similar to those caused by the virus of big bud have been observed by the writer, on non-solanaceous plants. It therefore appears that the virus has a wide host range. This is supported by the evidence available from the U.S.S.R. and South India. It seems likely that the diseases known as " big bud " in Australia, " stolbur " and " montar " in the U.S.S.R. and " little leaf " in South India, are all due to the same virus or to very closely related viruses.

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NOTE ON THE RETURN FROM A STAND OF *EUCALYPTUS DIVES*.

At the present time, when the need for alternative avenues of production is becoming apparent to the primary producer, the value of the eucalypts as an oil crop is worthy of emphasis. Natural stands of the important oil-yielding eucalypts are now much reduced, and in the future the quantity of oil available is likely to be limited. In addition, the judicious planting of eucalypts would provide a safeguard against soil erosion.

The purpose of this note is to record the actual yield obtained from an area of the broad-leaved peppermint on inferior soil in the Braidwood district, and to indicate the degree of improvement possible with improved management, or under plantation conditions. The area studied is situated on the Bombay Road, five miles from Braidwood, and has a normal rainfall of 26-28 inches per annum. The soil is shallow and poor, sandy and stony in nature, and derived from quartz-porphyry or similar rock. It has a very low water-retaining capacity.

In its native state, the country supports a growth of *Eucalyptus dives* Sch. and other eucalypts, but in this locality the worthless species have been removed. The following returns have been obtained from a measured area of one acre, cut in July, 1940, three years after a previous cutting. (Figure 1 gives a view of the growth two years after cutting):

Figure 1.
Coppice growth of *E. dives*, two years after cutting, July, 1939.

Weight of foliage for distillation	1,507 lb.
Weight of oil obtained	50·5 lb.
Yield of oil	3·35%
Piperitone content	40-42%
Value (at still)	38/-

The value of the oil is based on present market price. The yield of oil, 3·35 per cent., is distinctly low, and may be due to the dry seasons experienced

during the past three years. The return, which is equivalent to 12/8 per annum, compares very favourably with that which could be obtained from sheep. When cleared, adjacent similar land is capable of supporting only one sheep to ten acres.

The three-year-old coppice growth which has been produced since the area was last cut (1937) formed dense clumps, reaching a height of up to twelve feet, and a spread of up to thirteen feet. There are approximately ninety such clumps on the area, but their distribution is uneven. The distribution for a representative part of the area is given in Figure 2. It will be apparent that many more trees could be carried. Nowhere on the area are the clumps so close as to cause serious competition, and the density of the stand and the consequent return could be doubled simply by planting seedlings to fill in the gaps.

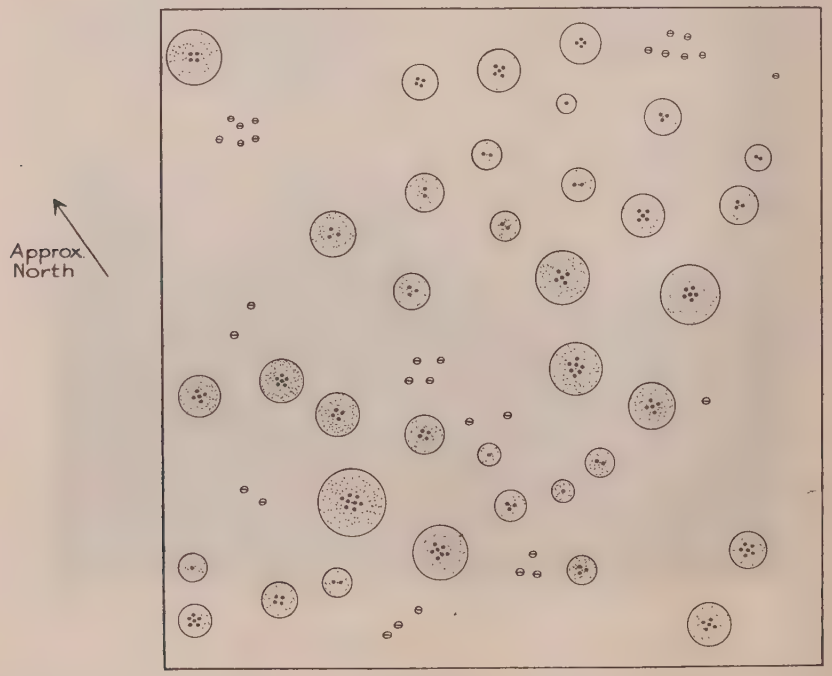

Figure 2.

Distribution of *E. dives* clumps on part of the area studied. The area plotted is two chains square. The spread of each clump is indicated by the circles. The number of coppice stems in each clump is also indicated.

Under plantation conditions, a spacing of eight feet between trees is not considered too close, but a spacing of twelve feet, giving three hundred trees per acre, would allow ample room for the trees. It is not suggested that

plantations should be undertaken on such poor soils as in the present example, but even in such cases yields of 4,000 lb. of leaf, or more, giving a very satisfactory return, should be obtainable.

Acknowledgment.

The Sydney Technological Museum is indebted to Mr. A. J. Bedwell for valuable assistance in the investigations, and to Mr. F. Scott for much of the data used in this note.

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VARIATION IN *HELMINTHOSPORIUM SATIVUM* INDUCED BY ZINC SULPHATE.

The beneficial effects on the growth of cereals, of small applications of zinc sulphate to the soil in the Victorian Wimmera district have been previously described.[2] As an outcome of this work a study, among others, of the effects of zinc on the development of cereal root-rot fungi was undertaken. While the principal results of this work will be published elsewhere, it is thought that the effects of relatively high concentrations of zinc sulphate on the development of *Helminthosporium sativum* would be of interest to readers of this Journal.

Preliminary studies set out in the report referred to above[2] indicated that growth and sporulation of certain root-rot fungi on glucose agar containing 0·1 to 0·5 per cent. zinc sulphate were very appreciably reduced.

Further work showed that on such media, sectors were often induced in *Fusarium culmorum* and *H. sativum* (Fig. 1). No such variation had previously been observed in these fungi after numerous transfers on potato dextrose agar containing no added zinc. On the zinc-containing media the sectors generally first began to develop in about four days. Microscopic examination of these outgrowths and the parent colonies revealed striking differences between the appearances of the mycelium (Fig. 2).

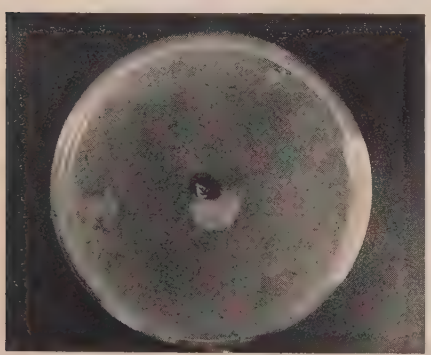
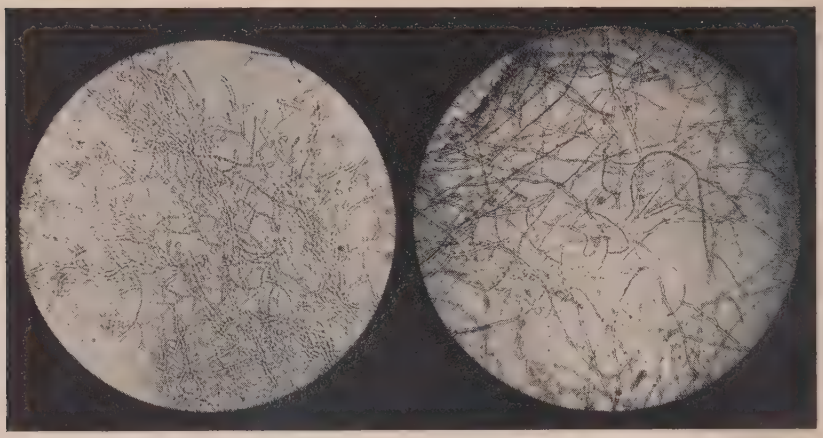


Figure 1.
A sector in *H. sativum* grown on glucose agar containing 0·5 per cent. zinc sulphate.



A B

Figure 2.
Mycelium of parent (A) and sector (B) shown in Figure 1.

Whereas the mycelium of the parent colony was thickened and very distorted, that of the sector was undistorted and apparently normal. No sporulation was observed, however, in either the parent colonies or the sectors.

It was obvious that the sector showed a very much greater tolerance for zinc than did the parent mycelium, leading to a markedly improved growth on the zinc-containing media.

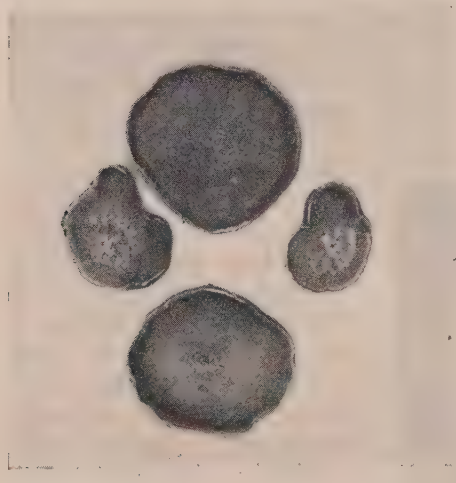


Figure 3.
Appearance of parent and sector of *H. sativum*, originally produced on glucose agar containing 0·5 per cent. zinc sulphate, after six successive transfers to potato dextrose agar. *Top and bottom*: parent; *left and right*: sector.

When portions of the sector and parent colonies respectively were transferred to potato dextrose agar containing no added zinc, the relative growth rates of the parent and sector were completely reversed—i.e., the parent colonies grew considerably faster than the sector colonies. Sporulation occurred in all colonies.

These cultures were incubated at 25° C. for ten days and transfers were then made from them to fresh potato dextrose agar. This procedure was repeated for six successive trans-

fers. After these transfers the same relative differences in growth between the parent and sector colonies still existed (Fig. 3).

It was apparent, therefore, that in the original culture on glucose agar the zinc had induced a stable variant. The work of Dimock[1] has shown that such zinc-induced sectors must be regarded as mutations. He found that a similar variation to that described above was induced in *Fusarium oxysporum* var. *gladioli* in the presence of a high concentration of zinc. The evidence that he obtained indicated that the changes were induced by the action of the zinc ion on the nuclei or cytoplasm of the parent mycelium.

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THE SPECIFIC GRAVITY OF COWS' MILK.

The specific gravity of milk varies both with temperature and the amount of dissolved and suspended matter which it contains. Determinations are either made at 60° F. or corrected to this temperature. If the temperature at which the determination is made is reasonably close to 60° F., a fairly close approximate correction can be made by adding 0·0001 for every degree above or by subtracting 0·0001 for every degree below 60° F. More exact corrections can be made by using a slide rule or consulting a table such as that compiled by Richmond,[1] Van Slyke[2] or Vieth.[3] A search through the literature, however, has not revealed any information giving corrections for the specific gravity of milk determined at temperatures greater than 80° F. In many tropical laboratories the daily temperature range lies above 80° F., and it is not always convenient or practicable to lower the temperature of the milk to this temperature before determining the specific gravity.

The object of this investigation was to obtain concise information which would enable the specific gravity of cows' milk, determined at any temperature within the range 40° F. to 90° F., to be corrected to the arbitrary temperature of 60° F.

Temperature Corrections.

In Table 1 figures are given for the correction of the specific gravity of cows' milk to 60° F., when determined at any temperature within the range 40° F. to 90° F. The table is essentially Richmond's table extended to cover a wider range of temperature. The additional figures were obtained by observing the change in specific gravity of a large number of milk samples as the temperature was increased from 40° F. to 90° F. and taking the mean of all

TABLE I.

Temperature. ° F.	Initial Reading.	1·025	1·026	1·027	1·028	1·029	1·030	1·031	1·032	1·033	1·034	1·035	Temperature. ° C.
40	To be subtracted from reading.	0·0015	0·0015	0·0016	0·0017	0·0017	0·0018	0·0019	0·0020	0·0021	0·0022	0·0023	4·44
41		0·0014	0·0015	0·0015	0·0016	0·0017	0·0017	0·0018	0·0019	0·0020	0·0021	0·0022	5·00
42		0·0014	0·0014	0·0015	0·0015	0·0016	0·0017	0·0017	0·0018	0·0019	0·0020	0·0021	5·56
43		0·0013	0·0014	0·0014	0·0015	0·0015	0·0016	0·0017	0·0017	0·0018	0·0019	0·0020	6·11
44		0·0013	0·0013	0·0013	0·0014	0·0015	0·0015	0·0016	0·0017	0·0017	0·0018	0·0019	6·67
45		0·0012	0·0012	0·0013	0·0013	0·0014	0·0014	0·0015	0·0016	0·0017	0·0017	0·0018	7·22
46		0·0011	0·0012	0·0012	0·0013	0·0013	0·0014	0·0014	0·0015	0·0016	0·0016	0·0017	7·78
47		0·0011	0·0011	0·0011	0·0012	0·0012	0·0013	0·0013	0·0014	0·0015	0·0015	0·0016	8·33
48		0·0010	0·0010	0·0011	0·0011	0·0011	0·0012	0·0012	0·0013	0·0014	0·0014	0·0015	8·89
49		0·0009	0·0010	0·0010	0·0010	0·0011	0·0011	0·0012	0·0012	0·0013	0·0013	0·0014	9·44
50		0·0009	0·0009	0·0009	0·0009	0·0010	0·0010	0·0011	0·0011	0·0012	0·0012	0·0013	10·00
51		0·0008	0·0008	0·0008	0·0009	0·0009	0·0009	0·0010	0·0010	0·0011	0·0011	0·0012	10·56
52		0·0007	0·0007	0·0007	0·0008	0·0008	0·0008	0·0009	0·0009	0·0009	0·0010	0·0010	11·11
53		0·0006	0·0006	0·0007	0·0007	0·0007	0·0007	0·0008	0·0008	0·0008	0·0009	0·0009	11·67
54		0·0005	0·0006	0·0006	0·0006	0·0006	0·0006	0·0007	0·0007	0·0007	0·0008	0·0008	12·22
55		0·0005	0·0005	0·0005	0·0005	0·0005	0·0005	0·0006	0·0006	0·0006	0·0007	0·0007	12·78
56		0·0004	0·0004	0·0004	0·0004	0·0004	0·0004	0·0005	0·0005	0·0005	0·0005	0·0005	13·33
57		0·0003	0·0003	0·0003	0·0003	0·0003	0·0003	0·0003	0·0004	0·0004	0·0004	0·0004	13·89
58		0·0002	0·0002	0·0002	0·0002	0·0002	0·0002	0·0002	0·0002	0·0003	0·0003	0·0003	14·44
59		0·0001	0·0001	0·0001	0·0001	0·0001	0·0001	0·0001	0·0001	0·0001	0·0001	0·0001	15·00
60		0	0	0	0	0	0	0	0	0	0	0	15·56
61	To be added to reading.	0·0001	0·0001	0·0001	0·0001	0·0001	0·0001	0·0001	0·0001	0·0001	0·0001	0·0001	16·11
62		0·0002	0·0002	0·0002	0·0002	0·0002	0·0002	0·0002	0·0002	0·0003	0·0003	0·0003	16·67
63		0·0003	0·0003	0·0003	0·0003	0·0003	0·0003	0·0004	0·0004	0·0004	0·0004	0·0004	17·22
64		0·0004	0·0004	0·0004	0·0004	0·0005	0·0005	0·0005	0·0005	0·0005	0·0006	0·0006	17·78
65		0·0005	0·0005	0·0005	0·0005	0·0006	0·0006	0·0006	0·0006	0·0007	0·0007	0·0007	18·33
66		0·0006	0·0006	0·0006	0·0007	0·0007	0·0007	0·0007	0·0008	0·0008	0·0008	0·0009	18·89
67		0·0007	0·0007	0·0008	0·0008	0·0008	0·0008	0·0009	0·0009	0·0010	0·0010	0·0010	19·44
68		0·0008	0·0009	0·0009	0·0009	0·0009	0·0010	0·0010	0·0011	0·0011	0·0011	0·0012	20·00
69		0·0009	0·0010	0·0010	0·0010	0·0011	0·0011	0·0011	0·0012	0·0012	0·0013	0·0014	20·56
70		0·0010	0·0011	0·0011	0·0012	0·0012	0·0012	0·0013	0·0013	0·0014	0·0015	0·0015	21·11
71		0·0012	0·0012	0·0012	0·0013	0·0013	0·0014	0·0014	0·0015	0·0015	0·0016	0·0017	21·67
72		0·0013	0·0013	0·0014	0·0014	0·0015	0·0015	0·0016	0·0016	0·0017	0·0018	0·0019	22·22
73		0·0014	0·0015	0·0015	0·0015	0·0016	0·0017	0·0017	0·0018	0·0019	0·0019	0·0020	22·78
74		0·0015	0·0016	0·0016	0·0017	0·0017	0·0018	0·0019	0·0019	0·0020	0·0021	0·0022	23·33
75		0·0017	0·0017	0·0018	0·0018	0·0019	0·0019	0·0020	0·0021	0·0022	0·0023	0·0024	23·89
76		0·0018	0·0018	0·0019	0·0020	0·0020	0·0021	0·0022	0·0023	0·0023	0·0024	0·0026	24·44
77		0·0019	0·0020	0·0020	0·0021	0·0022	0·0022	0·0023	0·0024	0·0025	0·0026	0·0027	25·00
78		0·0021	0·0021	0·0022	0·0022	0·0023	0·0024	0·0025	0·0026	0·0027	0·0028	0·0029	25·56
79		0·0022	0·0022	0·0023	0·0024	0·0025	0·0025	0·0026	0·0027	0·0029	0·0030	0·0031	26·11
80		0·0023	0·0024	0·0024	0·0025	0·0026	0·0027	0·0028	0·0029	0·0030	0·0032	0·0033	26·67
81		0·0025	0·0025	0·0026	0·0027	0·0028	0·0029	0·0030	0·0031	0·0032	0·0033	0·0035	27·22
82		0·0026	0·0027	0·0027	0·0028	0·0029	0·0030	0·0031	0·0033	0·0034	0·0035	0·0037	27·78
83		0·0027	0·0028	0·0029	0·0030	0·0031	0·0031	0·0033	0·0034	0·0036	0·0037	0·0039	28·33
84		0·0029	0·0030	0·0030	0·0031	0·0032	0·0033	0·0035	0·0036	0·0037	0·0039	0·0041	28·89
85		0·0030	0·0031	0·0032	0·0033	0·0034	0·0035	0·0036	0·0038	0·0039	0·0041	0·0043	29·44
86		0·0032	0·0033	0·0033	0·0035	0·0036	0·0037	0·0038	0·0040	0·0041	0·0043	0·0045	30·00
87		0·0033	0·0034	0·0035	0·0036	0·0037	0·0039	0·0040	0·0041	0·0043	0·0045	0·0047	30·56
88		0·0035	0·0035	0·0037	0·0038	0·0039	0·0040	0·0042	0·0043	0·0045	0·0047	0·0049	31·11
89		0·0036	0·0037	0·0038	0·0039	0·0041	0·0042	0·0044	0·0045	0·0047	0·0049	0·0051	31·67
90		0·0038	0·0039	0·0040	0·0041	0·0042	0·0044	0·0045	0·0047	0·0049	0·0051	0·0053	32·22

the readings at each temperature. Determinations were made with a Westphal balance. The range of observed readings is from 1·025 to 1·035. It has been found that only on very rare occasions does the specific gravity of a genuine mixed milk, determined at any temperature between 40° F. and 90° F., lie beyond this range.

Before a correction figure can be obtained from Table 1, it is first necessary to correct the observed specific gravity reading to the third decimal place, and although the correction figures are given to the fourth decimal place, the corrected specific gravity will not necessarily be correct to more than three decimal places. However, the error will not amount to more than 0·0001 and for most analytical work is of no importance. Nevertheless, it is customary in many laboratories to read specific gravities to the fourth decimal place, and these specific gravities may be easily corrected to the same degree of accuracy by either expanding Table 1 to eleven times its present size or by the use of an equation which will now be derived.

If we plot correction against temperature for each observed reading, a series of curves are obtained. The equations to these curves are as follows :

	(B)	(A)				
Correction	$=0\cdot0000954t$	$+0\cdot000001035t^2$	when	initial	reading	is 1·025
,,	$=0\cdot0000980t$	$+0\cdot000001052t^2$	,,	,,	,,	,, 1·026
,,	$=0\cdot0001010t$	$+0\cdot000001069t^2$	,,	,,	,,	,, 1·027
,,	$=0\cdot0001045t$	$+0\cdot000001086t^2$	,,	,,	,,	,, 1·028
,,	$=0\cdot0001083t$	$+0\cdot000001103t^2$	,,	,,	,,	,, 1·029
,,	$=0\cdot0001126t$	$+0\cdot000001120t^2$	,,	,,	,,	,, 1·030
,,	$=0\cdot0001173t$	$+0\cdot000001137t^2$	,,	,,	,,	,, 1·031
,,	$=0\cdot0001224t$	$+0\cdot000001154t^2$	,,	,,	,,	,, 1·032
,,	$=0\cdot0001280t$	$+0\cdot000001171t^2$	,,	,,	,,	,, 1·033
,,	$=0\cdot0001339t$	$+0\cdot000001188t^2$	,,	,,	,,	,, 1·034
,,	$=0\cdot0001403t$	$+0\cdot000001205t^2$	,,	,,	,,	,, 1·035

where t=temperature—60°.

To obtain a relationship between the B's and the initial readings, and the A's and the initial readings let

$$B=b_0+b_1i+b_2i^2$$

and $$A=a_0+a_1i$$

where i=1,000 (initial reading, 1·030).

Then from the method of least squares,

$b_0=0\cdot0001126$ $\qquad$ $a_0=0\cdot00000112$

$b_1=0\cdot00000449$ $\qquad$ $a_1=0\cdot000000017$

$b_2=0\cdot0000002I$

and by substitution we have the general equation

$$\text{Correction}=\frac{(1\cdot126+0\cdot0449i+0\cdot0021i^2)t+(0\cdot0112+0\cdot00017i)t^2}{10000}$$

which gives the correction to be added to or subtracted from an observed

specific gravity reading to correct it to the arbitrary temperature of 60° F. when an accuracy of four decimal places is required. A negative solution means that the correction is to be subtracted, and a positive solution that it is to be added.

This expression has been found by experiment to hold for the temperature range 40° F. to 90° F. and for initial specific gravity readings ranging from 1·025 to 1·035, but it is reasonable to assume that it will also hold for temperatures and specific gravities outside these ranges providing they are within certain limits where are never or rarely exceeded in practice.

Influence of Composition.

The specific gravity of milk fat varies more with temperature than that of any other constituent of milk, but there is approximately twenty-four times more fat-free milk than fat in whole milk, so that the fat-free portion is by far the greater factor influencing changes in the specific gravity of milk.

Consider two milk samples with the same specific gravities at a certain temperature. These milk samples will not necessarily have the same specific gravities at any other temperature, for they may not have identical compositions. However, it will now be shown that this difference in specific gravity due to a difference in composition is not greater than 0·000036 over the range 60° F. to 90° F. and may be ignored in general practice. Consider two milk samples at 60° F. with the following hypothetical analyses in which the percentages of fat have been adjusted so that the milks have the same specific gravities initially.

Sample.	Percentage of Fat.	Percentage of Fat-free Milk.	Density of Fat.	Density of Fat-free Milk.
A	6·1296	93·8704	0·9396	1·0351
B	2·6644	97·3356	0·9396	1·0317

Then from the mixture law,

specific gravity of A=specific gravity of B
=1·029246.

Now raise the temperature of these milks to 90° F. Figures for the specific gravity of the milk fat and fat-free fractions at this temperature are 0·9186 and 1·0320 and 1·0280 respectively. Then,

Specific gravity of A=1·025049
,, ,, ,, B=1·025085

and the difference in the specific gravities is 0·000036. This figure is much larger than we are likely to meet with in practice, for we have considered two

milk samples in which the specific gravities of the fat-free portions differ greatly and in which the correction has been made over a range of 30° F.

Summary.

1. A table has been obtained which enables the specific gravity of milk obtained at any temperature within the range 40° F. to 90° F. to be corrected to 60° F.

2. An equation has been derived which gives the correction figure to be added to or subtracted from any specific gravity obtained within the range 40° F. to 90° F. to correct it to 60° F.

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(1) Richmond, H. D., Dairy Chemistry, London, 1930.
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ON THE OCCURRENCE OF THE WEEVIL *NAUPACTUS LEUCOLOMA* BOH.* IN AUSTRALIA.

Specimens of a weevil collected in lucerne at Warrah Creek, New South Wales, were identified as *Naupactus leucoloma* Boh. by Sir Guy Marshall in a letter dated 1st June, 1933. In the same letter it was stated that the species was originally described from North-west Argentina and had also been recorded from Chile and Uruguay. This information was embodied in a note(1) in the *Review of Applied Entomology*.

In 1936, *N. leucoloma* appeared in Florida and has since received much attention from various workers in the United States, where it is known as the white-fringed beetle. The species is regarded by the U.S. Department of Agriculture as a potentially serious pest. This estimate(2, 6) is based on several aspects of the weevil's behaviour : (*a*) the very wide range of its host plants ; (*b*) the destructiveness of both the adult and the larval stages ; (*c*) the various ways in which it may be spread ; and (*d*) the parthenogenetic mode of reproduction(4) of the species, which must assist colonisation. Recent legislation(2) has imposed quarantine measures designed to restrict the infestation to its present limits in Florida, Louisiana, Mississippi and Alabama.

Host Plants.

In one district in Alabama, 234 plant species were found attacked by *N. leucoloma*.(5) These hosts include the main field and vegetable crops of the Gulf States, also weeds and grasses, garden flowers and shrubs, wild bushes, trees and vines. Maize, cotton, peanuts and potatoes were found especially liable to attack.

* This species is now placed by Buchanan(3) in the genus *Pantomorus*, subgenus *Graphognathus*.

In New South Wales, however, the host plants so far determined are extremely few in number. In the Hunter River districts, vegetable crops, particularly French beans, cauliflowers and cabbages, are attacked. However, lucerne (alfalfa) appears to be the chief host plant of the white-fringed beetle in New South Wales, although this plant does not appear in Young and App's list of the plants more commonly attacked in U.S.A.

From various reports one expects that further field work will discover many new host plants in Australia, especially among weeds, vegetables and garden flowers.

Distribution.

Apart from one infestation near Bellbrook, Macleay River, this weevil has been found only in parts of the Hunter Valley (from Morpeth to Scone) and in the immediate hinterland of the Hunter, across the Dividing Range. In the last-named zone, at Warrah Creek (near Willow Tree), the species was found attacking lucerne late in the autumn of 1932 and in January, 1933.

All these infestations will be seen to lie within 110 miles of the coast and between Lat. 30° 40′ and Lat. 32° 50′. It is interesting to note that the Northern Hemisphere infestations occur in similar latitudes. In U.S.A., twenty out of the twenty-three infested zones listed by Young and App fall between Lat. 30° and Lat. 32° 30′. The other three zones are all grouped within a radius of about 30 miles of New Orleans, which itself lies on Lat. 30°.

Life History.

The life history of *N. leucoloma* under Australian conditions has not yet been worked out. However, many observations on its seasonal behaviour have been made and these can be summarised as follows :

(*a*) Late-instar larvæ in N.S.W. have been found in each of the ten months, February to November. The abundance of advanced larvæ in February makes it certain that larvæ will be found in the other two months, December and January. (Young and App[5] state that although the average larval period is 10·7 months, a proportion of the larvæ fail to pupate during the summer and persist as full-grown larvæ. Some larvæ which hatched during 1937, though apparently full-grown in 1938, did not pupate during the latter year.)

(*b*) Watson[4] quotes a letter from W. B. Gurney in which it was stated that the winter in N.S.W. was passed in the larval stage. This view is supported by the writer's field experience to date. From June to September larvæ are abundant and easily secured, but no living pupæ or adults have been obtained during those months.

(*c*) Pupæ are known to occur in the months October, November, February and March. Further investigation will no doubt reveal their presence in December and January.

(*d*) To date live adults have been obtained only in the seven months November to May inclusive. It is believed that the bulk of the adult population dies off with the onset of severe cold in June, for large numbers of weathered exoskeletons of dead adults have been found in July. (The average length of life in the adult stage as ascertained by Young and App was 14 weeks. Exceptional individuals lived up to 171 days as adults.)

(*e*) Oviposition is known to occur during May.* Its incidence in the

* For this record I am indebted to Dr. Ann R. Sanderson, Research Fellow of the Women's College, Sydney University.

other months has not been investigated. (American work[5] shows egg laying from July to November. On this basis, one expects oviposition in Hunter River districts from January to May inclusive.)

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[1] Anon. Rev. Appl. Ent., 21 : 303, 1933.
[2] Anon. U.S. Dep. Agr. B.E.P.Q., Q. 72, 1939.
[3] Buchanan, L. L. U.S.D.A. Misc. Pubn. 341, 1939.
[4] Watson, J. R. Florida Ent., 20 : 22-25, 1937.
[5] Young, H. C., and App, B. A. Mimeographed Circ. E 464, U.S.D.A., 1939.
[6] Young, H. C., App, B. A., Green, G. D., and Dopson, R. N. Mimeographed Circ. E 420, U.S.D.A., 1938.

AFTER-EFFECTS OF FEEDING QUEENSLAND FRUIT FLIES ON POISON BAITS.

A regular feature of the toxicity tests for the control of Queensland fruit flies has been the survival of considerable percentages of flies in some of the experiments. Odd individuals survive even periods of 14 days, and for this reason the time taken to give a complete kill would not give a true indication of the mortality of the more typical individuals which are considered to be represented in the 25 to 75 per cent. range of mortality.

During the past few seasons general satisfaction has been expressed by commercial fruitgrowers who have used the sodium fluosilicate-sugar foliage poison spray, and it was therefore considered possible that flies taking sub-lethal doses of poison were rendered incapable of laying eggs, or deposited only sterile eggs. Sazonov and Skryabina* have reported than 75-80 per cent. of third instar hoppers of *Locusta migratoria* which survived toxicity tests with sodium arsenite and sodium fluosilicate became adult and subsequently deposited eggs of which 45-67 per cent. were sterile.

Flies were taken from one series of toxicity tests and placed in fresh cages containing a supply of sugar-peptone food and water. The percentage and number of flies surviving in this test are set out in Table 1.

TABLE 1.—*Survival of Queensland Fruit Flies in Toxicity Tests.*

Insecticide.	Number of Flies Tested.	Number of Flies Surviving.	Per cent. Flies Surviving.
1. Tartar emetic	117	46	39
2. Sodium fluosilicate (A)	101	53	52
3. Sodium fluosilicate (B)	89	57	64
4. Check	120	118	98

* Sazonov, P. V., and Skryabina, E. A. Rev. App. Ent. (A), 25 : 574, 1937.

Two days after the removal of the surviving flies, breeding records were commenced and continued over a period of several weeks. Apples were used as the host fruit, and in estimating the results fruits which showed obvious signs of fly development were placed in breeding jars and the resulting flies allowed to emerge undisturbed.

On the other hand, fruits in which fly development was not apparent after 14 days were examined and the number of eggs deposited recorded.

As the development of a few fertile eggs would mask the oviposition of numbers of sterile eggs laid in the same fruit, the figures given in Table 2 are obviously an under-statement of the position regarding possible metatoxic effects. In one example which may be quoted, 81 sterile eggs were removed from a fruit from which 20 flies ultimately emerged. Alternatively, the development of fly maggots in all fruits in the check series does not preclude the possibility that some sterile eggs were laid in these fruits.

TABLE 2.—*Breeding Records of Queensland Fruit Flies Surviving Toxicity Tests.*

Date of Egg Deposition.	Tartar Emetic.		Sodium Fluosilicate (A).		Sodium Fluosilicate (B).		Check.	
	Sterile Eggs	Flies Emerged	Sterile Eggs	Flies Emerged	Sterile Eggs	Flies Emerged	Sterile Eggs	Flies Emerged
April 6 ..	—	—	23	—	—	8	—	13
8 ..	—	—	2	—	13	—	—	30
9 ..	—	—	4	—	20	—	—	15
10 ..	—	—	—	11	2	—	—	31
11 ..	6	—	—	24	30	—	—	81
12 ..	12	—	—	89	—	15	—	31
15 ..	3	—	—	36	—	2	—	—
16 ..	—	—	—	33	—	31	—	21
18 ..	5	—	—	32	—	26	—	63
19 ..	—	1	—	6	—	9	—	77
22 ..	—	4	—	5	—	11	—	32
23 ..	—	19	—	—	—	40	—	10
26 ..	—	16	3	—	—	73	—	21
29 ..	—	4	—	—	—	4	—	29
Total sterile eggs ..	26		32		65		Nil	

The breeding records tabulated indicate that both tartar emetic and sodium fluosilicate exercise some metatoxic or after effect and flies surviving toxicity tests in which these poisons are used actually deposit a number of sterile eggs. The loss in fertility thus induced is not permanent and deposition of fertile eggs takes place after a period of approximately one week for sodium fluosilicate and two weeks for tartar emetic.

Some flies used in this series of experiments have successfully over-wintered, many individuals thus living for a period of at least seven months. Eggs were deposited at irregular intervals throughout the winter and at temperatures as low as 58° F. Adult flies continued to emerge from many

of the fruits infested during the winter. Approximately 30% of these winter-bred flies exhibited variations of chætotoxy. These variations appear to be due to development under low temperatures and not to any residual effect of previous feeding on poison mixtures. A small number of the variations have been found to be symmetrical in arrangement and on the basis of present schemes of classification, these flies would be included in a different genus from that of their parents.

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The Australian Institute of Agricultural Science

THIRD GENERAL MEETING

The third general meeting of the Institute was held at the School of Agriculture, Melbourne University, on 4th November, 1940, the chairman being the President, Professor R. D. Watt. Twenty-seven members were present, representative of each Branch of the Institute, excepting Queensland and Tasmania.

Introductory business having been completed, considerable discussion took place on the notice of motion submitted by the W.A. Branch—" That Clause IV of Article IV of the Articles of Association be deleted " ; and on the amendment submitted by the Queensland

Professor J. A. Prescott.

Director of the Waite Agricultural Research Institute, University of Adelaide, and Chief of the Soils Division, Council for Scientific and Industrial Research, who has been elected

President

of the Australian Institute of Agricultural Science for the ensuing two years.

Professor Prescott was educated at the University of Manchester, and in 1916 was appointed Chief Chemist and Superintendent of Field Experiments to the Sultanic Agricultural Society of Egypt, which position he held for eight years. In 1924, he was appointed Professor of Agricultural Chemistry in the University of Adelaide. He is a past President of the Australian Chemical Institute and of the Royal Society of South Australia.

Branch which favoured retention of Article IV, Clause IV with the additional requirement that a thesis be presented and approved. Both the motion and the amendment were rejected, but the following motion was carried : " That it be a direction from this General Meeting to Council that a Special Qualifications Committee be appointed to deal with all applications for admission to membership ".

The Potentialities and Population Survey Report was discussed, as also the report on Status and Salary Survey. It was agreed that " it be a recommendation to Council that the material contained in this Interim Report (Salary and Status) shall be used for presentation to the appropriate authorities only with the approval of Council ". The Foreign Plant Quarantine Report was fully discussed, and it was unanimously agreed : (i) that each State Sub-Committee should be asked to examine the present report in detail and offer suggestions for consideration by the Central Committee ; (2) that the position in regard to inter- and intra-State quarantine should later be examined as in the case of foreign plant quarantine ; and (3) that the final report of the Central Committee be forwarded to the Standing Committee of Agriculture as soon as possible.

The meeting closed at 5.5 p.m.

A dinner, arranged by the Victorian Branch, was held in the evening at the University Union, at which the Presidential Address (published in this issue of the Journal) was delivered by Professor Watt, and the new President of the Institute—Professor J. A. Prescott—was installed. The attendance totalled 88.

MEETINGS OF COUNCIL.

At the August meeting of Council, the following persons were admitted to corporate membership : H. Bartlett, K. G. Carn, W. D. Kerle, R. F. N. Langdon, A. A. Ross and A. J. Schindler. The financial statement showed a balance at bank of £192 1s. 3d.

At the September meeting, it was decided that the political and social aspects of the scheme to establish Jewish immigrants as a group settlement in the Kimberleys, W.A., were outside the province of the Institute, but from the information available Council considered that the use of this area for closer settlement warranted investigation, and that the launching of any such settlement scheme should be preceded by a thorough examination of the agricultural, pastoral and economic possibilities of the area. It was agreed that £100 be invested as Inscribed Stock in the next war loan. Regarding the A.C.T. proposal to protect the professional interests of members, Council decided that the appeal may be forwarded by a member to the Hon. General Secretary or the Branch Committee. If to the former, he shall immediately ask the Branch Committee to conduct an inquiry and report to Council within 21 days. If the appeal be made to the Branch Committee, it shall immediately notify the Hon. General Secretary and institute an inquiry, a report on which is to be submitted to the Council within 21 days from date of receipt of the appeal. The Council shall then decide what further action, if any, should be taken. The following were elected to corporate membership : P. R. Gorrie and K. Needham ; to student membership : G. P. Phillips. The balance at bank amounted to £192 12s. 4d.

At the October meeting, Council suggested that the joint committee of the Institute with the Australian Veterinary Association to examine ways and means of improving extension services in Australia should be limited in its scope to the position in N.S.W.—this view to be submitted to the A.V.A. The finances disclosed a balance at bank of £176 3s.

MEETINGS OF BRANCHES.

Canberra Branch.

At a general meeting on 5th August, members discussed methods of procedure for dealing with appeals to the Institute by members who consider that their professional career has been affected by unjust treatment. Information was obtained from the Australian Chemical and Veterinary Institutes, and the Commonwealth Professional Officers' Association, on their attitude towards this question. It was agreed by the meeting that the matter was worthy of special consideration, and that the Institute was bound, by its Memoranda of Association, to look after the professional interests of its members. The procedure to be adopted should be based on the principle that the individual concerned is a member of the Institute ; therefore his appeal should go to the Institute rather than to a Branch. The following resolution was carried unanimously :

" When a member considers that his professional career has been affected by unjust treatment, he has the right under clause 2 (VII and VIII) of the Memorandum of Association to appeal to the Institute for assistance. The appeal should be forwarded to the Hon. General Secretary and be considered by Council. If the appeal is not of a trivial nature, then the Council shall refer the matter to the Branch of which the appellant is a member. The Branch shall thereupon conduct an impartial enquiry and make recommendations to Council. The Council shall then decide on what further action, if any, shall be taken."

It was thought that the enquiry by the Branch should be conducted by an impartial sub-committee appointed by members of the Branch, and that the findings of the sub-committee should be reported to the Branch and then be forwarded to Council.

A report of the foregoing discussion was submitted to the Council for consideration.

The September meeting of the Branch was addressed by Dr. J. G. Davies, the subject being " Pasture Problems of Coastal and Sub-coastal Queensland ".

Victorian Branch.

On 9th August, Mr. G. H. Vasey, Lecturer in Agricultural Engineering, Melbourne University, led a discussion on Pasture Implements and Pasture Improvements. Referring to grass harrows and so-called pasture renovators, Mr. Vasey said that the only job that the majority of them could do was to spread cow manure. Very few of them are capable, in the hard soil conditions prevailing before the autumn rains, of making a seed bed for the reception of pasture seeds, either naturally fallen or artificially sown. Ordinary cultivators, scarifiers and combines and some of the heavier implements of the " pasture renovator " class are necessary for this work. In the matter of pasture sowing, it was pointed out that very few of the commercial seeders provided for covering the seeds after being deposited in the soil openings provided by the tynes of the pasture renovators. The disadvantage of most cereal combines is inadequate depth control, though it was suggested in the discussion that modern screw adjustment machines met this objection. It was stated that the shallow ploughing of pastures for reconstruction, in order as a rule not to turn in deeply the upper region of probable higher fertility, presented some difficulties. It was suggested that the rotary hoe had some advantages in this respect.

On 6th September Mr. J. McLaren spoke on " Britain's Food Supply ". He discussed the changes which had taken place in the average diet of the United Kindgom from 1909–1913 to 1937–1938. He showed that the change was qualitative rather than quantitative, the changes being on increased consumption of animal products, fruit and vegetables (excluding potatoes, which remained constant) and a decreased consumption of cereals. Using Sir John Orr's figures, it was shown how the consumption of various items varied with income, and attention was drawn to the fact that two-fifths of the United Kingdom's population had a sub-optimum diet. Great Britain's home production depended not only on imports of cereals and vegetable oil seed, but on imported fertilisers. She would have to go further for her phosphates, while Spain was now the only source of potassic fertilisers.

On 27th September, the speaker was Mr. R. T. M. Pescott, Entomologist of the Department of Agriculture, his subject being " Some Problems of Applied Entomology in Victoria ". Mr. Pescott discussed entomological problems which presented some difficulty in the way of control or the setting out of long-range experimental plots, e.g. cockchafers in pasture lands, apple thrips and plague locusts.

On 25th October, Mr. McIntosh Ellis, of Australian Paper Manufacturers Ltd., gave an address on " Comparative Comments on Forest Policy in Australia and other Lands."

South Australian Branch.

A meeting was held on 26th September, at which four papers were read on the merits of large scale and family farms in the future development of the country. Mr. E. J. Breakwell opened the discussion with a battery of arguments for the family farm. The agricultural efficiency of the two types of farming were discussed under three heads: first, comparing the productivity of the efficient commercial farm with that of the efficient small farm; second, considering the relative chances of attaining efficiency in either class of farming in Australia; and third, considering the agricultural abuses to which each class of farm is prone. On the score of efficiency the advantage appears to lie with the large farm, but a case was made out to show that the margin was not as great as some protagonists insist, and it has to be offset against other disadvantages. The speaker then dealt with the abuses of overcropping and overstocking and raised the point of what is the correct size of a family farm to prevent fluctuations in production affecting stability of the

owner. Mr. J. R. Goode dealt with the subject from the pastoral angle, indicating the difficulties entailed in summing up the virtues of small and large farms. The agriculturalist and grazier can evolve his own system of efficient land use only when the scientist has provided the basic data. Mr. T. H. Strong entered the lists on the side of the large scale efficient farmer. Prices on overseas markets are not sufficient for the average Australian farmer, and the Government has to bolster up primary industry. The policy of high land prices in booms has resulted in too small farms. The argument was developed for dairying, considering large organisations having 1,000 cows, medium size 300 cows, and small size 30 cows. Costs were worked out to show under efficient economic management the returns increasing with size of unit. The quicker and more complete application of scientific results to the large, professionally managed farm allows changes in policy and practice, backed by financial capacity to switch production from one channel to another if need be. Management with capital can be more flexible and take advantage of new ideas or current markets. The conclusion is that Australian dairymen are not able to stand up to overseas competition because of small holdings, small returns and lack of diversity in production. Mr. H. G. Andrewartha concentrated more on the social aspects of the subject. It is not sufficient to consider only technology and economies of production. The social organisation of the rural population is important, so that waste of energy may be minimised and that increase in efficiency is not accomplished at the cost of increase in misery of part of the population. The speaker covered facts in American industry to show the truth of the latter point. There are two alternatives: we can ignore the urge for commercial efficiency and throw the weight of the government into the scales in favour of the *status quo*, i.e. essentially family farms and a reduced living standard. The second alternative is a planned agricultural system, not as organised by the totalitarian countries or the "socialist planning" of Russia. Socialism in agriculture is an ideal to be attained only in co-operation with a similar system operating in secondary industry. Co-operative farming may be one useful step in the direction of efficient planned agriculture.

Queensland Branch.

On 30th August the second half of the symposium on plant improvement gave rise to an interesting discussion. Mr. R. E. Soutter, introducing the topic of wheat improvement, stated that wheat improvement in Queensland had its genesis in the nineties and the work is now being carried out in five centres on the Darling Downs and in the Maranoa. The loss of first crosses due to rust is minimised by concentrating crossing work at Roma, while Kincora, on the Downs, is useful for testing rust resistance. In seasons when rust infection is light, the next important character, grain quality, is used in selection work. The work on breeding for rust resistance has involved the introduction and breeding of hundreds of varieties. The recent introduction of highly immune varieties from Kenya has enhanced the prospects of breeding resistant varieties, but it will be necessary to improve grain quality. The application of the Pelschenke test enables grain quality to be assessed on the produce of a single plant and still leave planting material. Trials on revitalising of wheat varieties are in progress, to test the claim that crossing within the variety will restore vigour assumed to be lost by continuous self-fertilisation.

Mr. S. Marriott spoke on cotton improvement. The fibre or lint, to be satisfactory, must possess certain qualities of length, strength, drag and "character", lint percentage, lint index, and uniformity. In Australia the chief market is for medium stapled cottons of $\frac{15}{16}$" to $1\frac{1}{16}$". Fibre length is determined by $\frac{1}{16}$" classes, yet fibre from different bolls on the same plant may, when growing conditions fluctuate, vary by as much as $\frac{1}{8}$". Lint percentage, or the ratio of weight of lint to weight of seed cotton, is of importance from the point of view of plant economy, for, in a search for high lint percentage, seed weight may be sacrificed to a point where viability is involved. The factor, lint index, that is, the weight of lint per 100 seeds, is therefore used in conjunction with lint percentage in determining the status of a strain. In the Callide Valley the main problem is the development of a Jassid-resistant cotton for use in soft-wood scrub areas. Jassid resistance seems to be inherited as a complete dominant in the F1 generation. Resistance is definitely correlated with plant hairiness, and it has been demonstrated that, while all resistant plants are hairy, not all hairy plants are resistant. It is still not known whether Jassid damage is caused by specific poisons, virus or mechanical injury. Rhodesian cotton breeders have developed a resistant Upland cotton (U_4) by selection, but this variety is unsuitable here. In Queensland the problem is being approached along three lines: (1) the back-cross method, making crosses between U_4 and a commercial variety lacking resistance; (2) hybridisation followed by selection for the desired characters in the F2 and succeeding generation; and (3) selection from existing commercial varieties.

The meeting on 27th September was devoted to Notes and Exhibits. Mr. R. F. Langdon demonstrated a specimen of the grass *Ischaemum australe* infected with a smut as yet undetermined. Mr. C. S. Christian showed a plant of the so-called rhizomatous lucerne, collected from lucerne breeding plots at Lawes. Dr. D. A. Herbert exhibited specimens of diseases of pasture plants, many being the bases for new records. Mr. S. T. Blake showed a series of interesting photographs.

Current Notes and News

Agricultural Development in New Guinea.

The uncommon resources of the Mandated Territory of New Guinea were discussed in a lecture by Mr. R. E. P. Dwyer, Economic Botanist of the Territory, before the New South Wales Branch of the Institute on September 13th.

There are some 600 islands in the Mandated Territory, many of them very small. The total area is some 93,000 square miles, with 250,260 acres under plantation, producing approximately £1,000,000 worth of agricultural products. The planted acreage of New Guinea includes 240,000 acres of coconut, 2,600 acres of cocoa and 2,758 acres of other crops including coffee, various native food plants—taro, yams, sweet potatoes and maize, grown for plantation use, bananas, pineapples, cassava (tapioca), oil plants, quinine and species of Derris. The three main species of sugar-cane are grown—*Saccharum officinale, S. robustum* and *S. spontaneum*—and there are some 170 varieties. Considerable natural hybridisation occurs at the higher levels in particular. The natives tend to perpetuate soft shelled canes, of low sugar content, for chewing purposes. " Fiji disease " is prevalent. Among fruits, quality avocados, mangos and paw-paws are produced but are rarely turned to useful economic purpose. Tobacco which was introduced, most likely through Java or the Philippines early in the 17th century, is of a type similar to the progenitor of the American cigar types.

The area in the Territory suited for rubber cultivation has never been accurately determined. It is certain that much more suitable land than labour is available. There is little doubt that 40,000 hectares could be devoted to rubber planting in New Guinea and a large proportion of it could consist of areas in any case unsuited to coconuts or the next important crop, cocoa. Incidentally, although several types of rubber, e.g. castilloa, were originally planted, only *Hevea brasiliensis* and *Ficus elastica* are being tapped.

Jungle products and timber products occur in great variety. Amongst the former are Mangrove bark, Candle nut (comparable for some purposes with tung oil), rattan, sandalwood, sago, gum dammar and copal, cinnamon, massoi and other barks containing essential oils. Timber to the value of £6,000 per annum is now exported from the Mandated Territory, and this trade will increase. New Guinea walnut is especially valuable. Kamarene, one of the only two *Eucalyptus spp.* in the Territory, is confined largely to river areas. It grows to 240 feet, has an immense trunk, and is harder and more durable than most tropical timbers.

The minor forest products of New Guinea should be carefully studied for their economic possibilities, e.g. paper pulp (also from grasses), brush fibres from palms, power alcohol, match splints, tannins, oils, resins, gums and dyes. New Guinea can grow pulping woods in a fraction of the time required in the non-tropical zones.

The Department of Agriculture has a European personnel of 22 members, and expends approximately £16,000 to £18,000 on plant introductions and various small experiment farms which are concerned with plant introductions and distribution, cross-breeding and selection. The Botanic Gardens at Rabaul are used as a centre of distribution for economic plants. At the major experiment station, Kerevat, there are approximately 400 crops under cultivation. One of the administrative achievements of the Department has been the institution of copra inspection, which saved about £350,000 per annum and raised the price of copra for " hot-air grades " £1 per ton over all other South Sea copras. Recently an experiment station has been established at Aujura on the inland plateau for the investigation of quinine, *Coffea arabica*, pyrethrum and various protein-rich foods such as peanuts and soya beans. Tea is also being grown there, but owing to international restrictions it has not been possible to acquire the best types.

Reorganisation in the N.S.W. Department of Agriculture.

A reorganisation of the N.S.W. Department of Agriculture was announced by the Minister for Agriculture, Major A. D. Reid, M.C., M.L.A., in September last, the basis of the change being the grouping of cognate but previously separate Branches into Divisions.

Dr. R. J. Noble was appointed Under Secretary and Director of the Department, and seven Divisions were constituted as follows:

1. Division of Plant Industry comprising experiment farms, field, agrostological, plant breeding and tobacco branches of the Department. A biometrician has been transferred to the Division to provide assistance in the planning and examination of results of departmental investigations. Mr. A. H. E. McDonald, H.D.A., has been designated Chief of Division; Mr. H. Wenholz, B.Sc.Agr., Deputy Chief.
2. Division of Horticulture includes fruit, exports and imports, and viticultural branches, with Mr. G. C. Savage, R.D.A., as Chief of Division.
3. Division of Animal Industry includes animal health and livestock production services, comprising stock, sheep and wool, herdmaster's, piggery, poultry and apiarist's branches, with Mr. M. Henry, M.R.C.V.S., B.V.Sc., as Chief of Division.
4. Division of Dairying involves change of designation for the existing branch, with Mr. O. C. Balhausen as Chief of Division.
5. Division of Science Services includes biological, botanist's, entomological and chemist's branches, with the Under Secretary acting as Chief of the Division.
6. Division of Marketing comprises State Marketing Bureau, and a section of agricultural economics, with Mr. A. A. Watson as Chief of the Division.
7. Division of Information and Extension Services represents a new development in the organisation of the Department. It includes the publications branch and library, and a service which will assist in the co-ordination of instructional activities of the Department. Mr. C. C. Crane, B.A., is Chief of this Division.

Correspondence

STUDY OF LAND RESOURCES.

Editor,
Journal of the A.I.A.S.
Dear Sir,

Land use mapping has become a fashionable subject, and schemes are mooted for large-scale work on State-wide areas. The object is most worthy. A knowledge of land resources, agricultural values and potentialities is a prime requirement in Australia, and it is high time the work was systematically undertaken. It is, indeed, a national and Commonwealth matter, and if the States are to tackle it within their borders the plan of attack and execution should be thorough and uniform in all.

There are two points I would like to make. The first is that generalisations are not really much good. We have plenty of authorities ready to make rough estimates—what is required is a sound study. Opinions differ on the detail required, but I suggest firmly that unless considerable detail is included on the maps the work is inadequate. We are inundated with maps of Australia showing various features with smooth line boundaries; surely in this attack on land use we want specific data and reasons for present state and future expectation. We want detail, particularly on key areas, for either development or on the score of active degeneration, and detail cannot be obtained without close work by an experienced team. It is better, if funds and men are limited, to concentrate on such key areas rather than spread out thinly over very large territories. If the aspect of soil erosion alone is to be included (and this is essential) an assessment of a State presents a very large problem for a small team of workers.

The second point is that doing land use work without a soil classification is like drawing up a budget of expenditure without knowing where the money is to come from. The soil is fundamental to any land use investigation. A proper study of the soils need not involve a full-dress soil survey, but an intelligent reconnaissance by surveyors trained for the work can supply the basic pattern on which changes in agricultural usage are superposed. On this unchanging foundation soil deterioration is mapped as one of the changeable features, along with crops, etc. Present use is a stage in agricultural development; equally we want assessments of potential uses and a flexible plan for future progress—flexible because ten or twenty years of research and experiment will alter our ideas on what may best be done with the land. When these future land use maps are made it will not, of course, be necessary to draw maps of the soil types if they are properly classified in the first plan.

This is a plea for an examination of ideas and methods for the study of land resources as a prelude to embarking on any large area investigation without letting magnificent magnitude obscure the necessity of essential detail in a sound planning scheme.

Yours, etc.,
J. K. TAYLOR.

Division of Soils,
Council for Scientific and Industrial Research,
Waite Institute, Adelaide, S.A.
5th November, 1940.

Book Reviews

THE RAPE OF THE EARTH, by G. V. JACKS and R. O. WHYTE.

(*xvi*+285 *pp. with* 48 *illustrations. Faber and Faber, London. Price* 21/- *nett.*)

Broadly, the material in this book with a dramatic title, is treated in three ways, the first of which deals with the erosion position in various countries—Europe, North and South America, Africa, Australia and the Orient. The second concerns the principles of soil conservation proceeding to specific aspects as agronomic control, reclamation of gullies, modern practice in grassland management, the importance of trees as protective cover and their influence in flood control, " dust dunes and desert ", the modern road system as a factor in initiating destructive run-off, and lastly the conservation of wild life resources. The third line of attack discusses the impact of erosion on the world today in its economic consequences and covers at length its political and social consequences, especially in North America, Australia and Africa.

The outline of the progress of soil erosion in the main eroded regions of the world is perforce sketchy, occupying little more than 50 pages. The preservation of a granular structure is discussed at length as a feature of prime importance affecting erodibility of soils, but there seems to be some exaggeration of the salinity factor with over-emphasis on the " terrors " of " black alkali ". The most interesting sections are the six chapters completing the book. They deal with the influence of world and national economics on the intensity of land use and exploitational farming with illustrations of results in several countries.

As with most cases of joint authorship, there is inequality of treatment. The impression of repetition also remains. For general students and the intelligent layman this book is a useful compilation. It is not meant to be a technical treatise, but for many of us it should inspire some thought on the implication of soil erosion in the process of national and international development.

J. K. TAYLOR.

FIELD PLOT TECHNIQUE, by W. H. LEONARD and A. G. CLARK.

(271 *pp. Mimeoprint. Burgess Publishing Company, Minneapolis, Minnesota,* 1939. 3.25 *dollars.*)

This book, from the Agronomy and Mathematics Departments of Colorado State College, whilst primarily a lecture manual, will also be of service to the agricultural worker. It should help considerably in shortening the lag between the appearance of the many recent developments in logical experimentation and modern principles of design and their proper understanding and appreciation by the experimenter.

The book is simply, accurately and interestingly written and the text is clear and easily readable. Very considerable detail is given in regard to design, layout and conduct of experiments, with special reference to field work, and, in addition, there is a full, concise treatment of elementary statistical methods. Throughout there is a background of insistence on, and explanation of, the logical background of experimentation and the introduction of methods is interwoven with their application.

The book covers a very wide field in proportion to its size, this being accomplished by use of a succinct, didactic style, and reference of the reader to literature citations at the end of each chapter. It concludes with six tables—area under the normal curve, F and t, χ^2, Naperian logarithms, angular transformation (Bliss) and random numbers.

F. C. McCLEERY.

Personal Notes

Dr. N. S. Noble, Entomologist in the N.S.W. Department of Agriculture, and Business Manager of this Journal, has been appointed Secretary of the Linnean Society of N.S.W. He will enter upon his new duties on January 2, 1941.

Mr. H. J. Geddes has been appointed Garland Lecturer in Animal Husbandry at the University of Sydney, and Officer-in-Charge of the McGarvie Smith Animal Husbandry Farm at St. Marys, N.S.W.

Mr. G. Loftus Hills, who was Bacteriologist at the Co-operative Butter Factory, Maffra, has been appointed Biochemist in the Division of Industrial Chemistry, C.S.I.R.

Mr. F. S. Crawford has resigned from the Victorian Department of Agriculture to join the staff of the " Weekly Times ", Melbourne, as an agricultural journalist.

Mr. F. C. McCleery has been appointed Biometrician in the N.S.W. Department of Agriculture.

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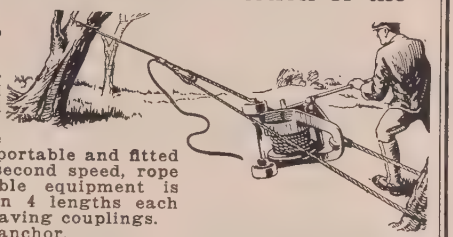

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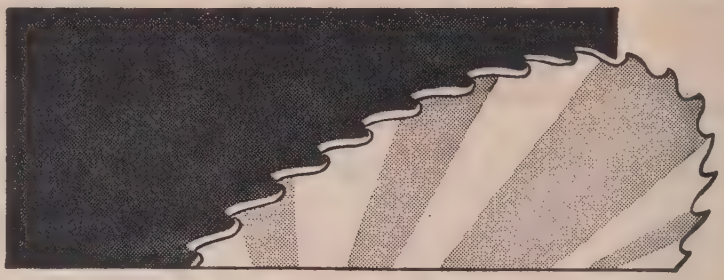

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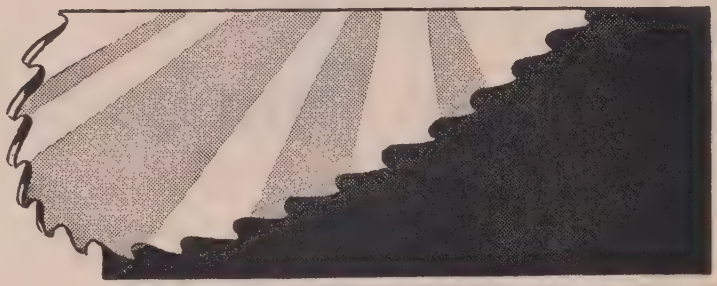

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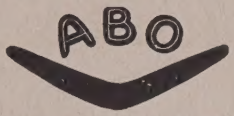

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